IRVM

Integrated Roadside Vegetation Management

Iowa's Roadside Resource

INTEGRATED ROADSIDE VEGETATION MANAGEMENT

Technical Manual

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BY
Josh Brandt
Kirk Henderson
Jim Uthe

EDITOR
Maria Urice

TECHNICAL REVIEW
Wes Gibbs
Linn Reece
Jon Steege

United States Department of Agriculture
NRCS Natural Resources Conservation Service

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ABOUT THIS MANUAL

The objective of this publication is to provide basic technical support for new and existing Iowa county roadside programs. The manual is also intended to provide guidance to policymakers and engineers interested in adopting or expanding integrated vegetation management in county right-of-way.

Producing a manual that accurately describes the various aspects of integrated roadside vegetation management is best accomplished through a collaborative, integrated effort. Many of Iowa's current roadside practioners provided valuable assistance to the manual's editorial team. Their expertise was instrumental to the creation of the manual and greatly appreciated.

Most of the photos in the manual were provided by the authors and roadside practioners. Other image contributions are noted. Manual layout and design: Maria Urice.

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Note about updates (2015):
Brief updates were made to the digital version of the Technical Manual in May 2015. A more complete revision of the manual – first published in 2011 – will take place at a later date. Contact IRVM Program Manager Kristine Nemec with comments about the current manual or its eventual revision: kristine.nemec@uni.edu.

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Introduction

What is IRVM?

Integrated Roadside Vegetation Management is an approach to right-of-way maintenance that combines an array of management techniques with sound ecological principles to establish and maintain safe, healthy and functional roadsides. The IRVM tool chest includes judicious use of herbicides, spot mowing, prescribed burning, mechanical tree and brush removal and the prevention and treatment of disturbances to existing vegetation. IRVM's long-term objective is to reduce roadside maintenance by creating stands of durable, long-lived, native plants.

History

IRVM was introduced to Iowa in the mid-1980s in response to the need for groundwater and surface water protection. Prior to that time roadside weed control had relied exclusively on herbicides, with most counties employing an application method known as *blanket spraying.* Besides being expensive and potentially harmful, blanket spraying was an ineffective means of weed control, creating openings for weeds by stressing and weakening roadside grasses and eliminating beneficial broadleaf species. Iowa counties were spending a lot of money putting large amounts of herbicide into the environment and, at the same time, making little or no headway in the control of roadside weeds. Clearly, this type of roadside management proved unsustainable.

Another development of the mid-1980s was the Iowa Department of Transportation's use of native prairie grasses and wildflowers for erosion control. A few county conservation boards were also experimenting with this naturally adapted, alternative vegetation for roadsides. When the Iowa Legislature officially adopted IRVM in 1988, the cornerstone of the program became the establishment and protection of native vegetation in Iowa roadsides. The Living Roadway Trust Fund was created the following year, supporting state, city and county roadside projects.

Since that time over 100,000 acres of state and county road right-of-way have been planted to native vegetation. Diverse stands of 15-45 prairie grass and wildflower species – all naturally adapted to local growing conditions – provide stable, low-maintenance roadsides for Iowa.

IRVM Program

Goals

- Maintain a safe and effective road system.
- Provide responsible and sustainable vegetation management.
- Make the most of Iowa's immense, 700,000-acre, roadside resource.

Basic tenets

- Prevent soil erosion.
- Control undesirable species in roadsides.
- Do not rely exclusively on herbicides.
- Plant the best-adapted vegetation.

Progress to date

- Herbicide use in Iowa roadsides has been reduced to spot-spray application.
- Iowa DOT and half of Iowa's counties routinely plant native vegetation.

The challenge

- Get the remaining counties to place more of a priority on roadside vegetation. Many of these counties are not so much against IRVM as they simply are not inclined to do much of anything with their roadsides.

The road to success for county roadside management

- Create a full-time roadside manager position.
- Hire a conservation-minded individual to run the program.
- Give the roadside manager the power to succeed.

The Integrated Toolbox

- Utilize the principle of species diversity for a strong, weed-resistant plant community. No single species is adapted to all roadside conditions. IRVM employs a mix of species suited to the range of growing conditions in a typical roadside and the varying climate conditions of an Iowa growing season. Any roadside planted to a monoculture will develop gaps for weeds to exploit.

- Use herbicides sparingly. Overuse of herbicides weakens stands of grasses, allowing increased weed invasion. Careless use of herbicides also destroys beneficial broadleaf species that would otherwise help prevent weeds by occupying the same niche sought by broadleaf weeds.

- Make more effective use of herbicides by spraying smarter with better training, better timing and better technology.

- Prevent disturbances. Farm field runoff and herbicide over-spray are common disturbances from adjacent land that destroy roadside vegetation and cause more weeds. Work with individual landowners to enlist their cooperation in reducing these negative impacts.

- Conduct prescribed burns to promote healthy native vegetation. By burning native plantings every 3-5 years or so, trained and well-equipped crews use fire as the most effective means of managing fire-adapted prairie species.

- Mow patches of weeds to reduce seed production and seed dispersal.

- Use a variety of means to clear brush and trees before they block the vision of motorists, obscure signs and become dangerous obstructions to errant vehicles.

The Benefits of Native Vegetation

Iowa road departments plant native vegetation for a variety of reasons:

- Native plants are durable, long-lived perennials well-adapted to Iowa's climate and growing season.
- A diverse native planting adapts to a wide range of soil and moisture conditions.
- Native plants perform well in poor soils.
- Extensive, native plant root systems provide superior erosion control.
- Deep roots and dense, above-ground foliage reduce stormwater runoff by intercepting raindrops, slowing water flow and increasing infiltration.
- Extensive roots and decaying foliage further increase stormwater infiltration by adding organic matter to the soil, making it spongier and more absorbent.
- Root systems penetrate 6-8 ft. or deeper, enabling prairie plants to survive drought and high salt concentrations.
- Extensive root systems deprive weed roots of water, nutrients and space.
- Tall prairie vegetation shades out Canada thistle and other weed seedlings.
- A wide swath of prairie grass in the right-of-way traps blowing snow, increasing the storage capacity of the ditch and reducing the amount of snow deposited on the road.
- Native roadside plantings provide valuable food and cover for songbirds, game birds and small mammals.
- Native roadside plantings provide important habitat for agricultural crop pollinators.
- Native plants add color and natural beauty to the right-of-way.
- Tallgrass prairie roadside plantings restore a piece of Iowa's natural heritage.

Iowa's County IRVM Programs

In 2011, fifty counties had active Integrated Roadside Vegetation Management programs. Programs with a full-time roadside manager are shown below in green. Counties that seed some native vegetation and/or manage invasive species without a roadside manager are shown in yellow.

Iowa's IRVM programs operate within different departments:

Secondary Roads Conservation Board Independent

Chapter 1 provides information about IRVM program organization.

1 IMPLEMENTING IRVM AT THE COUNTY LEVEL

Starting an Integrated Roadside Vegetation Management Program

Counties choose IRVM because they want:

- More organized and proactive roadside management.
- More responsible and sustainable roadside vegetation management.
- More cost-effective roadside management.
- To manage roadsides for multiple purposes.
- To take advantage of the Living Roadway Trust Fund.

The Full-time Roadside Manager

The best way to achieve these goals is to hire a full-time roadside manager. As the one overseeing all vegetation management activities, this person is focused and motivated to:

- Perform weed and brush control activities in a timely, effective manner.
- Save money by conducting more in-house operations.
- Stay current with the latest products and technologies.
- Establish and maintain healthy stands of native vegetation.
- Install and maintain erosion control measures.
- Submit LRTF applications to bring in additional resources that address county needs.

As the county's vegetation specialist, a roadside manager takes ownership of the county's roadsides with pride and accountability. When one person coordinates every aspect of the program, the result is better roadsides.

A Less Expensive Way to Get Started

A few counties have managed to plant a lot of roadsides to native vegetation without hiring a roadside manager. These counties don't get the same level of vegetation management but they do access the Living Roadway Trust Fund. The following are examples of how this has been accomplished:

- The county engineer and conservation board director work together. The engineer applies for the seed – for ditch cleanouts and road projects – and conservation does the planting.
- The county finds a current employee (e.g., the engineer or somebody working under the engineer) who personally wants to see the county get active in IRVM. In addition to his/her

regular duties, this person applies to LRTF for seed and works with road maintenance personnel to get it planted.
- The county looks for a vegetation-savvy individual already on staff in secondary roads – or elsewhere – and makes it part of his/her job to send in LRTF applications and do the planting.

Hopefully these efforts lead to the establishment of a full-time roadside manager position. Planting native vegetation and maintaining healthy roadsides takes a sustained, focused effort. Even the board of supervisors cannot make this happen without having someone in a key position who wants the program to succeed.

Where's the Savings?

Long-term savings are anticipated through the establishment of native plant species as better-adapted, more competitive vegetation. Immediate savings are realized by:

County personnel spot-spraying brush.

- Having county personnel with LRTF-purchased seed and seeding equipment reseed after road projects.
- Having county personnel with LRTF-purchased equipment spray roadside weeds instead of hiring a contractor.
- Having county personnel with equipment partially paid by the LRTF conduct tree and brush removal operations.
- Having county personnel install and maintain erosion control measures instead of hiring it done.

A professional vegetation specialist on staff can provide additional savings by:

- Conducting stormwater inspections required under NPDES (National Pollution Discharge Elimination System).
- Doing wetland delineations.
- Preparing wetland monitoring reports for mitigations.

The Role of an IRVM Citizen Action Group

Occasionally members of the public have worked to change their county's roadside management practices. Historically this has involved concerned citizens – residents of the county who want less roadside spraying and more native vegetation. The effort can start with one person or a small group who recruits like-minded friends and associates. They meet informally, someone presides, someone takes minutes and they lay out their goals over the course of a few meetings. They may contact the IRVM Program Office at the University of Northern Iowa for help at any time during the process: 319-273-2813.

Eventually this group will approach the county board of supervisors – the ultimate policy-making body at the county level. The board of supervisors may prove more receptive if the citizen group includes people such as an NRCS employee or SWCD commissioner, a CCB or DNR natural resource manager, a member of a habitat group, someone representing farming interests, an educator, a botanist or a weed control professional. The point is to fortify the effort with respected individuals who can address the board of supervisors with candor and knowledge.

When the citizen group is ready, it should arrange a meeting with the board to present the outlined goals. Unless the supervisors are able to clear most of the agenda for one of their regular meetings, a special meeting will facilitate better discussion. Most of the citizen group members need to be present. The desired outcome at this time is for the board of supervisors to appoint a formal IRVM committee to look closely at the county's current roadside management program and determine what's best for the county. Recommended IRVM committee membership can include: a member of the board of supervisors, the county engineer, the road superintendant/foreman, the weed commissioner, a member of the conservation board and key members of the original committee.

Assessing the County's Current Roadside Vegetation Management Program

The **County Vegetation Management Survey** *(Appendix 1a)* can serve as a basis for evaluating a county's roadside vegetation management program. Obtaining meaningful responses may require interviews with members of the road maintenance crew or others directly involved. Consider county herbicide-use records, noting herbicide products, quantities and costs. Consider spray records to determine who does the spraying, when it occurs, the technology used and the miles covered each year.

Though responses to the survey questions can be subjective, they will help identify and prioritize personnel and equipment needs. The process will involve compromise. In the end, weed and brush control objectives are balanced against environmental concerns and limited county resources. With that in mind, determine an appropriate allocation of county resources. Also determine how much might be solved with better organization and efficiency.

A successful outcome to this process would be to have the board of supervisors dedicate a full-time position and budget to roadside vegetation management. The next step is to hire a resourceful person motivated to get the most done within that budget.

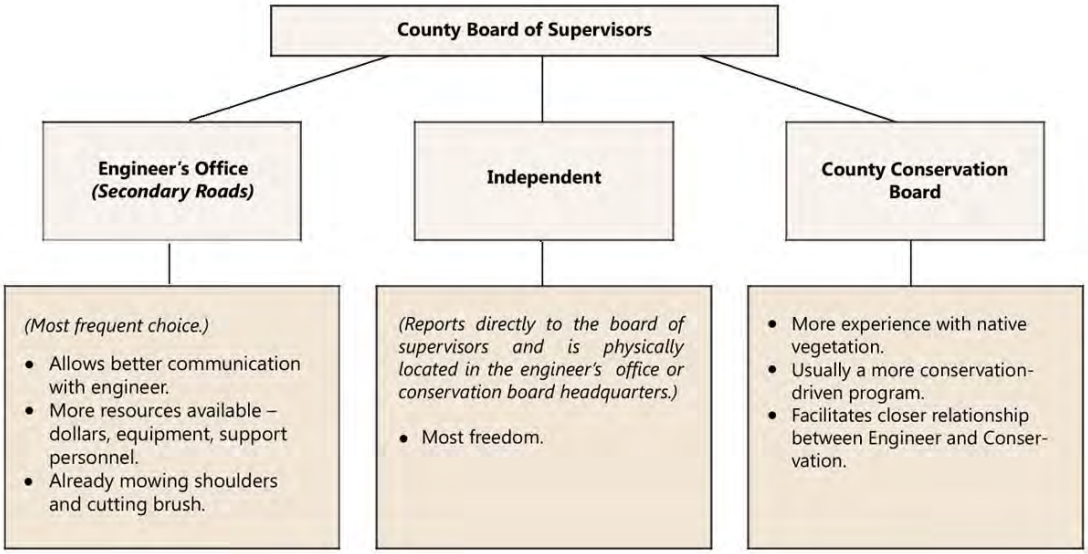
After a roadside manager is hired, the IRVM committee can become the IRVM steering committee, meeting with the new roadside manager monthly for the first year and quarterly thereafter. This committee sees that things are done as needed, supports the roadside manager's efforts and provides political support in times of need.

Hiring a Roadside Manager

Ideally the county will hire a roadside manager with wide-ranging knowledge and skills. The best candidates have a strong equipment background and good communications skills. Experience with natural resources and/or vegetation is an important bonus. Candidates must like a challenge and be willing to learn as they go. It's best to have the roadside manager onboard before developing the county's IRVM plan or conducting the roadside inventory. A generic position description *(Appendix 1b)* can be personalized to fit your county's situation.

IRVM Program Organization

When deciding where to locate the IRVM program and who should supervise the roadside manager, keep in mind that greater independence allows for better planning and timely operations. Sometimes reorganizing within a department or restructuring of departments is necessary to give roadside management personnel the autonomy to meet objectives. County programs operate successfully within the engineer's office, the county conservation board or as an independent department. All three have advantages.



Ideal Program Needs

Personnel

- Full-time vegetation specialist/roadside manager
- Full-time or 9-month roadside technician/assistant roadside manager
- Two seasonal employees

Equipment

- Tractor, 60 hp with dual rear axle
- 3/4-ton pickup, large enough for fire pumper unit
- Flatbed truck for herbicide spray rig
- Truck or trailer for hydroseeder
- 6-foot Truax native grass drill
- Spray rig with chemical injection and multi-control spray head
- Hydroseeder, 800-gallon or larger with mechanical agitation
- Broadcast seeder
- Straw mulch blower
- Cultipacker
- Boom mower
- Chainsaws
- Brush chipper

Taking Advantage of the Living Roadway Trust Fund

Since 1990, counties have enjoyed support from the Iowa Department of Transportation's Living Roadway Trust Fund. Roadside managers submit applications each year to acquire resources for their program. The LRTF does not fund salaries, trucks or tractors. Beyond that, it's up to the county to be resourceful. While eligibility for this funding requires only that a county have an IRVM plan on file with the Iowa DOT, a county's commitment to IRVM is a factor when grant applications are reviewed. A full-time roadside manager on staff demonstrates strong commitment. Applications are due each year on June 1.

Examples of LRTF-funded items

- Roadside inventories
- Seeding equipment:
  Native grass drills
  Hydroseeders
  Broadcast seeders
- Discs, harrows, cultipackers
- Native seed
- Seed storage rooms
- Prescribed burn equipment:
  Pumper units
  Backpack pumps
  Drip torch and hand tools
  Protective clothing
- Public education
  Workshops
  Signage
- Training/Continuing ed
- GPS units
- Digital cameras
- Silt fencers
- Straw mulch blowers
- UTVs
- Brush chippers
- Equipment sheds

Full or partial LRTF funding is available for items such as hydroseeders, ATV fire rigs, native seed and signage and wetland delineation training.

Program Responsibilities

- Seeding and hydromulching road and bridge projects and ditch cleanouts.
- Installing erosion control measures.
- Conducting prescribed burns in stands of native vegetation.
- Spot-spraying roadside weeds.
- Responding to weed complaints.
- Keeping records on herbicide use and roadside plantings.
- Writing grant applications for LRTF funding.
- Cutting trees and brush.
- Spraying small trees and brush.
- Maintaining equipment.
- Ordering supplies.
- Working one-on-one with landowners to reduce their impact on roadsides.
- Attending training and maintaining herbicide-applicator certification.
- Conducting stormwater inspections.
- Preparing wetland mitigation reports.
- Providing educational programs for the public.

IRVM personnel brush cutting in the winter, attending burn training in the spring, leading a native vegetation field day in the summer.

Annual Operations

- Tree and brush control, depending on the method, can be done year-round.
- Ideally, seeding occurs in May/June and fall, but can be done whenever the ground is not frozen or snow-covered.
- Weed spraying is best in May, June and September but happens in the summer too.
- Prescribed burning is mostly in April and May, with some burning in late summer and fall.
- LRTF applications are due June 1.

Winter responsibilities

- Mapping and inventory.
- "Spare" truck driver (with CDL).
- Prepare reports and maintain records.
- Work with engineer on budget and propose equipment needs.
- Research equipment possibilities and draft concept statement for LRTF application.
- Write burn plans.

Developing an IRVM Plan

The IRVM steering committee works with the roadside manager to develop the county's IRVM plan. The plan:

- Establishes clear expectations for the roadside manager.
- Sets annual and long-range goals and objectives.
- Provides overall guidelines for the way the program operates.

Developing a plan should be a priority as it is required to establish the county's eligibility for LRTF funding. The LRTF provides an IRVM plan outline, and posts approved county plans on its website.

Conducting a Roadside Inventory

The most effective roadside management starts with accurate information about roadside conditions. Information collected in a roadside inventory includes herbaceous cover, tree and brush cover, weed concerns, bare areas and areas with erosion and encroachment. The inventory process typically involves a windshield survey of roadside conditions throughout the county, recorded every quarter mile, or as needed. The individual (or individuals) conducting the inventory must be able to identify weeds, distinguish native prairie vegetation from non-native grasses and recognize areas of erosion and encroachment. If more than one individual is conducting the inventory, a leader must provide training to ensure accurate, uniform data collection.

LRTF funds can be used to hire someone to do the inventory. The roadside manager and county engineer are included in planning and training so the collected data will be of maximum use to the county. Six to eight weeks are allowed for the process, ideally in late summer and fall since this is the easiest time to identify stands of native vegetation.

Inventories funded by the LRTF must be recorded on GPS devices. Software for collecting and recording roadside inventory information has been developed and is available free of charge from the LRTF. The LRTF also funds the purchase of GPS units, mapping software and laptop computers.

Inventory information helps set management priorities and provides baseline data for measuring program success.

Roadside Prairie Remnants

Every county in the state has a few roadsides containing small patches of native plants descended from the original prairie. Prairie remnants, as they are called, may possess just a few species of note or they may be quite diverse. Either way they provide a glimpse of the past and are valued as sources of genetic material and models for future prairie restoration. They all merit protection.

Look for prairie remnants where an old railroad right-of-way parallels the highway or where land may have been too rocky or too wet to till. A thorough survey of roadsides in your jurisdiction is the best way to document the location of remnants and prevent their destruction in the future. Generally, do not try to enhance a remnant by inter-seeding with native seed unless that seed comes from remnants in the immediate vicinity.

Comments

Starting an IRVM Program

When considering the establishment of a new IRVM program, consider: money spent in weed control, money spent in contract seeding, money spent contracting erosion control, money spent on erosion stone vs. best management practices. There's lots of money to be saved with an IRVM program. Make it about money! ***Wes Gibbs, Jones County, 2010***

Depending on the size of a county's projects and how much spraying, contract seeding and maintenance is done, an IRVM program can save enough money to pay a roadside manager's salary each year. On top of that, the county does not have to deal with contracts and has more control over how things are done. ***Wes Gibbs, Jones County, 2010***

Nowadays, creating a new position for a roadside manager might be difficult. So a realistic inventory of existing personnel is in order. Who has a green thumb? Who has the political savvy to survive? After appointing a roadside manager, an inventory of equipment and facilities is next. It's way easier to start a program if existing tractors, trucks, etc. can be used at first. When times get better, the program can grow. ***Joe Kooiker, Story County, 2010***

I wouldn't over-publicize a new program. It can bring too much scrutiny and pressure. Hire or appoint a roadside manager and do some visible projects (seedings, erosion control, tree removal, etc.). Then promote the program through finished works. ***Jeff Chase, Des Moines County, 2010***

2 NATIVE SEED

Native seed for county rights-of-way

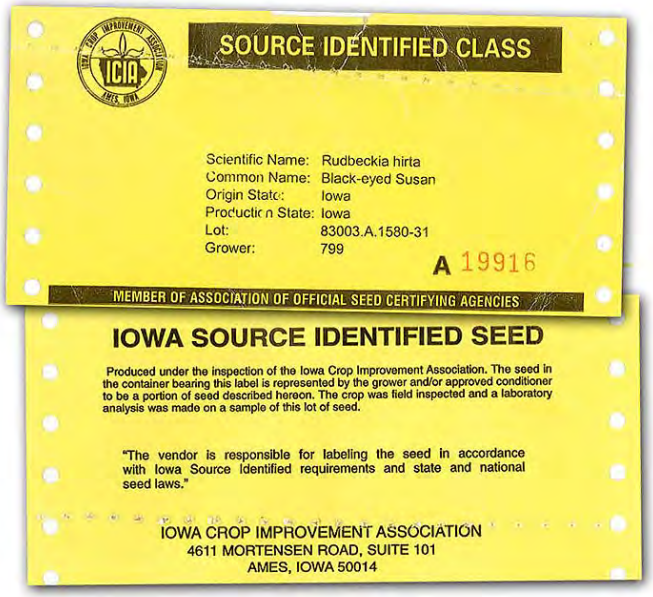
Since 1998, Iowa's Integrated Roadside Vegetation Management program has received funds from the Iowa DOT's Transportation Enhancement (TE) program to purchase native seed for county road rights-of-way. Counties may request a Diversity Mix (30-45 species) or a Clean-out Mix (15 to 20 species); both are suited to most roadside situations. The availability of TE mixes means counties purchase directly from commercial seed vendors only when they wish to supplement the TE mixes or when a unique mix is desired for a special project.

Native Seed Categories

Use seed adapted to local climate and growing conditions

Yellow-tag

Yellow-tag, source-identified seed is highly recommended for roadside plantings. Because this Iowa seed is certified as to source, the region and climate to which it is adapted are known. This seed is often collected from multiple sites within a region of the state, giving it a broad genetic base and potentially making it adapted to a wider range of growing conditions.



Yellow-tag seed is produced in fields that are inspected and certified annually by the Iowa Crop Improvement Association.

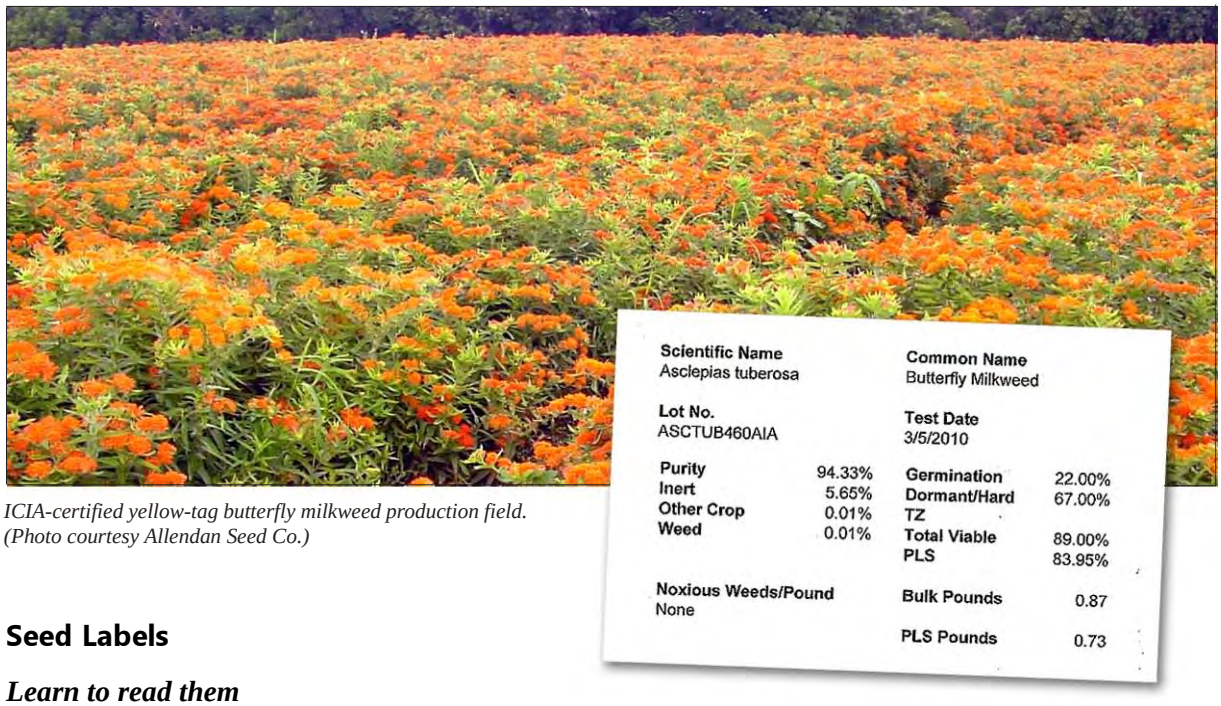
Local ecotype

Non-certified, local ecotype seed of Iowa or nearby origin is also appropriate for roadside plantings and can be obtained from seed vendors by requesting "local ecotype" seed. Some counties establish their own local ecotype prairie grass and wildflower production plots with seed collected from prairie remnants within their county or region. It is important for this seed to be well cleaned and tested so it is known how much live seed is actually being planted.

Cultivars

Cultivars or cultivated varieties are generally not recommended. Cultivars are often derived from sources too far south and west of Iowa and so are adapted to a different climate and growing season. Most were developed for forage production and can be too aggressive in diverse plantings. Cultivars are available in only a limited number of species.

Sources of yellow tag species and related information can be found in the Iowa Crop Improvement Association's Native Seed Directory. Additional native seed sources and information can be found at the Plant Iowa Natives website.



ICIA-certified yellow-tag butterfly milkweed production field. (Photo courtesy Allendan Seed Co.)

Seed Labels

Learn to read them

Commercial seed labels contain a variety of information related to quality of the seed. Some or all of the following items will be on the label:

- Pure seed (purity) – Percent of material in the bag that is actually the desired seed.
- Inert matter – Percent plant debris or other materials that are not seed.
- Other crop seeds – Percent non-weed seeds.
- Weed seeds – Percent seeds considered weed species.
- Name and number of noxious weed seeds per pound.
- Germination – Percent of seed that will germinate readily in a germination chamber.
- Hard seed – Percent of seed that does not germinate readily because of a hard seed coat.
- Dormant seed – Percent of seed that does not germinate readily because it requires a pre-treatment or weathering in the soil. (Some suppliers may combine hard and dormant seed on the label.)
- Pounds pure live seed (PLS) – (# PLS) = (# bulk) x (% purity) x (% germination + % dormant).

A "TZ" (tetrazolium) % may also be on the label. Some native species' seeds will not break dormancy for germination tests. These seeds can be biochemically tested using tetrazolium chloride (TZ). Living tissue is stained red, allowing analysts to determine the viability of non-germinated seed.

Seed stored for more than a year or grown/harvested "in-house" should be tested. The Iowa State University Seed Testing Laboratory and many private seed testing labs perform TZ tests as well as purity and germ tests, and will identify weed seeds in the sample. TZ test kits are also available.

Seed Storage and Viability

Keep seed cool and dry

The viability of native seed deteriorates rapidly at high temperatures and high humidity.

General rule of thumb for seed storage: ***Temperature plus humidity should not exceed 100.***

- Most seed will last at least a year at 50° Fahrenheit and 50% relative humidity.
- For each 10° increase in temperature, seed longevity is halved.
- For each 1% increase in moisture content of the seed (not RH), longevity is also halved.

Example: Seed stored at 70° and 6% moisture content has only one-quarter the life span of seed stored at 50° and 6% moisture. Likewise, seed stored at 50° and 8% moisture content has only one-quarter the life span of seed stored at 50° and 6% moisture.

"Ideal" seed storage requirements vary with individual species, but most can be stored in a temperature- and humidity-controlled environment for at least a year without losing significant viability. Some IRVM programs have a dedicated seed storage facility. These insulated rooms and small buildings are rodent proof and include air-conditioning units and sometimes industrial dehumidifiers.

In the absence of a seed storage facility, seed should be stored in the coolest place possible. Air circulation can improve conditions in spaces without temperature/humidity controls. Short periods of heat (over 100° F) can be tolerated by most seeds, but long-term exposure can destroy the embryo.

Commercially produced seed has been properly dried before being bagged. Ideally, seed storage bags should be made of breathable materials such as cloth or woven nylon. Well-dried seed (8-14% moisture content, depending on species) – if kept cool and dry – can be bagged and stored in garbage cans, plastic bags or other sealed containers without suffering damage from fungus or freezing. Watch for moisture build up.

Additional information on seed quality, processing and storage is found in *The Tallgrass Prairie Center's Native Seed Production Manual.*

This seed room is "sealed" with tin to keep out rodents and provide a moisture barrier.

A screened enclosure and a mudded, drywall ceiling (left) protect seed from rodents. Window and wall air conditioners and dehumidifiers create climate-controlled conditions (right).

Seed Mixes

Take advantage of prairie diversity

Native roadside seed mixes need to include species adapted to a wide range of growing conditions, from wet to mesic to dry. To outcompete weeds, the mix should also include species that occupy different ecological niches within the planting, grass species and broadleaf species, warm-season and cool-season species, tall plants to shade out thistle seedlings and small plants to fill in underneath.

When working in narrow ditches, such as those found within a 66 ft. right-of-way, it is most efficient to design one mix that includes species for a wide range of site conditions – from the gravelly, well-drained soils at the top of the slope, to the heavy, saturated soils at ditch bottom. Apply the same mix over the entire area and let it sort itself out. Wider rights-of-way may have wet or dry areas large enough to justify designing and planting a seed mix specific to those spots.

To achieve a well-rounded mix with all the benefits native vegetation has to offer, include species from each of the following functional groups. The IRVM office at UNI can help counties design mixes for unique sites or to supplement Transportation Enhancement mixes.

A well-rounded native seed mix will include species from each of these groups:

Quick-establishing

Some native species develop faster than others. These are important for early erosion control and provide positive PR while slower species establish.

- Canada wild rye *(Elymus canadensis)*
- Black-eyed Susan *(Rudbeckia hirta)*
- Rough dropseed *(Sporobolus asper)*
- Partridge pea *(Cassia fasciculata)*

Warm-season grasses

Roadside plantings rely heavily on these prominent members of the native plant community. These grasses continue to grow through the hot summer months. They provide long-term erosion control and good fall color.

- Big bluestem *(Andropogon gerardii)*
- Indiangrass *(Sorghastrum nutans)*
- Switchgrass *(Panicum virgatum)*
- Side-oats grama *(Bouteloua curtipendula)*

Cool-season species

Plantings are strengthened by a species component that greens up early in the spring. These plants provide late-winter/early-spring erosion control and occupy the niche sought by non-native, cool-season competitors like smooth brome.

- Canada wild rye *(Elymus canadensis)*
- Virginia wild rye *(Elymus virginicus)*
- Western wheatgrass *(Agropyron smithii)*
- Sedges *(Carex spp.)*

Legumes

The prairie flora includes many legumes that thrive in roadside plantings. They fix nitrogen and improve habitat.

- White wild indigo *(Baptisia leucantha)*
- Round-headed bush clover *(Lespedeza capitata)*
- Showy tick-trefoil *(Desmodium canadense)*
- Canada milk vetch *(Astragalus canadensis)*
- Purple prairie clover *(Dalea purpurea)*

Top to bottom: Partridge pea, Big bluestem, Canada wild rye, Purple prairie clover

Showy and easy

These species establish readily, are relatively inexpensive and create masses of color noticeable at 65 mph. They are crowd pleasers.

- Gray-headed coneflower *(Ratibida pinnata)*
- Ox-eye sunflower *(Heliopsis helianthoides)*
- Wild bergamot *(Monarda fistulosa)*
- New England aster *(Symphyotrichum novae-angliae)*
- Black-eyed susan *(Rudbeckia hirta)*

Showy

The following species cost a little more or are harder to establish but still add important color and habitat.

- Butterfly milkweed *(Asclepias tuberosa)*
- Prairie blazing star *(Liatris pycnostachya)*
- Compass plant *(Silphium laciniatum)*
- Pale purple coneflower *(Echinacea pallida)*
- Stiff goldenrod *(Oligoneuron rigidum)*

Early bloomers

It's relatively easy to extend a planting's blooming season into the fall. Spring color is harder to come by. The following plants provide the earliest color visible from the road.

- Ohio spiderwort *(Tradescantia ohiensis)*
- Foxglove beardtongue *(Penstemon digitalis)*
- Golden alexanders *(Zizia aurea)*
- Large-flowered beardtongue *(Penstemon grandiflora)*

Wet species

Upland species dominate roadside seeding mixes. Species adapted to wet areas are needed for moist ditch bottoms.

- Bluejoint grass *(Calamagrostis canadensis)*
- Swamp milkweed *(Asclepias incarnata)*
- Dark green bulrush *(Scirpus atrovirens)*
- Sneezeweed *(Helenium autumnale)*
- Mountain mint *(Pycnanthemum virginianum)*

Top to bottom: Gray-headed coneflower, Pale purple coneflower, Ohio spiderwort and Swamp milkweed

A note about tall grasses and non-native perennials

For visibility and safety, tall grasses – such as big bluestem and Indiangrass – should not be planted at intersections or driveways. Omitting these grasses throughout the remainder of a planting, however, will limit its adaptability. Big blue and Indiangrass are versatile, adapted to conditions from medium-dry to medium-wet. Short native grasses, on the other hand, are generally adapted only to dry sites.

Non-native perennials – such as tall fescue, perennial rye, crown vetch and birdsfoot trefoil – are very competitive and will persist to the point of adversely effecting survival of native seedlings. These species should not be used in permanent or temporary mixes for sites planted to natives.

Seed mixes for shoulders

Native species are not used on the shoulder. Examples of seed mixes that withstand repeated mowing and are well-suited to shoulder conditions follow.

- 50% Kentucky 31 fescue and 50% perennial rye
- 45% Kentucky 31 fescue, 45% perennial rye, 6% medium red clover and 4% alsike clover
- 35% Fawn fescue, 35% perennial rye, 20% timothy and 10% alfalfa or hairy vetch

Seeding Rates

Put down enough good seed to get timely vegetative cover and ensure planting success

Steeper slopes require heavier seeding rates. To get adequate erosion control, it's more affordable to increase the amount of grass in the mix than to increase forbs. The result is that roadside plantings tend to have a higher grass to forb ratio than other prairie restorations. No matter how much native grass seed is put down, at least a 25% forb component is recommended to achieve adequate diversity and long-term stability. A 50% forb component is considered adequate for a fairly diverse planting. Some counties – especially those with their own forb seed plots – may exceed 50% for intersections and other highly visible plantings.

Grass to forb ratio

To get adequate erosion control, it's most affordable to increase the amount of grass in the mix. No matter how much native grass seed is put down, at least a 25% forb component is recommended to achieve adequate diversity and long-term stability. 50% is better.

Seeding rates are calculated in one of two ways:

- Seeds/ft.^{2}
- Lbs./acre

Though frequently used, lbs./acre is not a precise way of measuring the number of seeds planted since seed weights vary greatly between species. For example, one ounce of compass plant contains 660 seeds, while one ounce of black-eyed Susan contains 92,000 seeds. When accurate calculations are desired, use seeds/ft.

Seeding rates for roadside mixes are determined by slope and – to a lesser degree – seeding method. Budgets can also be a factor. The following chart provides *general* guidelines – a good idea of how many seeds should be put on the ground.

Minimum recommended seeding rates

	Wildflowers		Native grasses
Level sites:	2 lb./A or 10 seeds/ft^2	+	7.5 lb./A or 30 seeds/ft^2
3:1 slopes:	3 lb./A or 15 seeds/ft^2	+	11 lb./A or 45 seeds/ft^2
2:1 slopes:	4 lb./A or 20 seeds/ft^2	+	15 lb./A or 60 seeds/ft^2

These rates apply to drill seeding, broadcast seeding and hydroseeding (two-pass method). When hydroseeding with seed mixed in the slurry (one-pass method), increase rates by 15-30% to compensate for seed hung up in the mulch. (Note: Under real working conditions, even the best attempts at measuring seed quantities in the field will not be perfectly precise.)

Sample native seed mixes are provided in Appendix 2a. A calculator for converting weight/A to seeds/ft.^{2} is here:

Calculating Seeds Per Sq. Ft. (Excel)

Diverse roadsides, like this excess right-of-way planting in Cerro Gordo County, are adapted to a wide range of growing conditions and can out-compete weeds.

Comments

Storage and Viability

We've noticed Liatris grows very poorly unless it's dormant seeded shortly after harvest. Perhaps it loses viability or vigor when stored over winter, or maybe it needs to be stored at a higher humidity than most seed. ***Jim Uthe, James Devig, Dallas County, 2010***

With a little increase in rate per acre, I think generally year-old seed can be used with no problem. We use older seed (2-3 years) at whatever rate it takes to use it up over the course of the season. I add a reduced rate of new seed to cover any loss of germination. ***Linn Reece, Hardin County, 2010***

Seed Mixes

The LRTF Native Plant Database includes information about each species range within the state of Iowa. This will be helpful for projects in which species native to the specific region are desired. ***IRVM Program Office***

Keep in mind in most situations we're not recreating a diverse prairie. We're stabilizing the roadside with native plants. ***Joe Kooiker, Story County, 2006***

Aspect/shading sometimes need to be taken into account, especially on small plantings or problem areas. In shaded areas, we use savanna species in the mix. If there's a lot of shade, we may plant a non-native, cool-season mix. ***Jim Uthe, James Devig, Dallas County, 2010***

On some areas we can afford to plant a diverse mix, but on many areas it's not worth the cost. This is due to disturbances or the fact that the area can't be well-managed because of steep slopes, the inability to burn, invasives, etc. ***Joe Kooiker, Story County, 2010***

Remember the forbs that pay the bills … like yellow coneflower and Monarda. They're colorful, easy-to-grow and cheap. ***Joe Kooiker, Story County, 2010***

Depending upon soil type, we may use an additional 1.5 - 2 times the rate of native grass on very steep areas to help speed establishment and stabilization, This will likely have a negative effect on forb diversity once established, but we feel diversity should take a back seat to slope stabilization on slopes 2:1 or greater. ***Jim Uthe, James Devig, Dallas County, 2010***

3 SEEDING

There is no single, correct way to seed native vegetation and there is no substitute for experience. Successful planting is the result of getting familiar with the equipment and developing the "art" – one's own way of working with natives. As a wise man once said: "It won't grow in the bag." The message: Don't worry so much about how to plant it. Get out there and start seeding.

Basic steps to successful seeding:

- Use good seed.
- Place seed in direct contact with the soil.
- Don't bury seed more than ¼ in. deep.
- Pack seed tightly to the soil.
- Include erosion control measures where necessary.
- Mow weeds during the first growing season.
- Conduct prescribed burns every three to five years.

Broadcast seeding in mid-fall following a ditch cleanout.

Timing

May and June are ideal seeding months, but road construction projects are rarely ready for seeding at this time. The following seeding calendar provides suggestions for protecting slopes and improving seeding success throughout the year.

January to mid-March
Winter months occasionally present windows of opportunity for frost seeding, a practice that originated as a way of incorporating seed into the soil when a native grass drill was not available. Seed is spread over bare soil made friable (loose or porous) by a cycle of freezing and thawing. Results can be good, but opportunities can be brief.

- Be ready to jump on it.
- Include oats as cool-season nurse crop.
- Do not frost seed on areas covered with ice or snow.*
- Frost seeding on slopes is not recommended.

*Occasionally native seed is sown on top of snow. Technically this is not frost seeding, but can be an effective seeding method on relatively level sites.

Late March through April
If site conditions permit (ground not frozen or too sloppy) this can be a good time for seeding. Warm-season grasses won't germinate until soil temperatures reach 60°. Include oats as cool-season nurse crop.

May and June
This time of year provides the best soil temperature and moisture conditions for germination and survival of warm-season species, including most prairie grasses and wildflowers.

Above: Hydroseeding a ditch cleanout in May, an ideal time for germination and survival of prairie species. Seeding opportunities exist at other times of the year, including late fall. These dormant seedings are best on level sites, like the large planting adjacent to highway right-of-way shown below.

July and August
Although every county can point to successful plantings during these months, hot, dry summer conditions are generally less favorable for planting natives. Consider a temporary seeding at this time, with the permanent, native seeding in the fall or the following spring.

If natives must be seeded now:

- Drill, rather than hydroseed, for maximum seed to soil contact.
- Increase seeding rate 25%.
- Include appropriate nurse crop.
- Mulch with straw, and crimp or tack straw into place.

September and October
Native seed germinating this late in the season is unlikely to develop enough root reserves to over-winter. Yet some of these plantings do succeed, maybe because a lot of the seed does not germinate until spring. Research is needed.

- Erodible sites must be stabilized with winter wheat.
- Increase seeding rate 25%.

November and December
Dormant seeding, considered a good option on level ground, is more complicated on erodible slopes. Cover crops seeded this late won't provide erosion control until spring. The majority of native seed will remain dormant over winter. While some forb species do better when dormant seeded, some of the native grass seed planted at this time will deteriorate over winter.

- Erodible sites must be stabilized with hydromulch or crimped/tacked straw.
- Increase warm-season grass rate 25%.

Site Preparation

Site preparation enhances seed to soil contact, helps ensure proper planting depth and can even provide erosion control.

Prior to working the site

- Walk the site looking for gullies, culverts and other hazards (e.g., logs, stones, stumps, etc.).
- If weed growth is excessive, mow and disk stubble into the soil, if possible.
- Check with utility companies before disking.
- Calculate the size of the area to be planted and the amount of seed it will take.
- Size up the watershed and the site's erosion potential.

Seedbed preparation for drill seeding

Ideal seedbeds are friable, firm and smooth.

- To reduce soil erosion, don't smooth up the site until just before planting.
- Relatively level sites can be worked with a disk, chain-tooth harrow or similar equipment.
- To avoid excessive clodding, don't work the site while it's too wet.
- Cultipacking can help firm the seedbed and reduce clods.

Seedbed preparation for hydroseeding

Seedbeds can be left rougher to reduce soil erosion.

- Steep slopes can be ripped with a wide-track dozer.
- Directional tracking can be used to interrupt water flow.
- Work the site perpendicular to the slope to interrupt water flow.

Heavily compacted soils

- Try to work the site to a depth of 3 in.
- A heavy disk might be necessary.
- Some sites may need to be worked with long bulldozer tines.

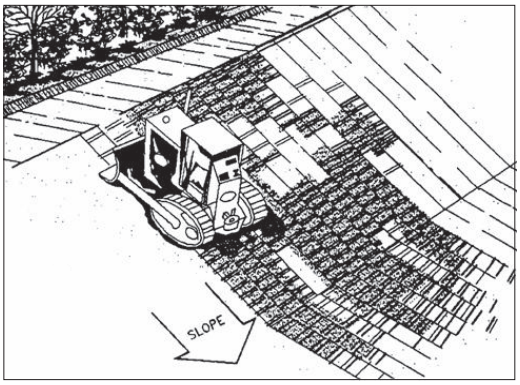


Image source: U.S. Army Corps of Engineers

A variety of implements can be used to prepare a seedbed. The most appropriate equipment depends primarily on slope, soils and seeding method.

The diagram at right illustrates directional tracking: dozer treads create grooves perpendicular to the slope.

Cover Crops

There are two kinds of cover crops. Cover crops planted along with the permanent seed mix are called *nurse crops* or *companion crops*. Those planted by themselves pending a better time to plant the permanent mix are referred to as *temporary seedings* or *stabilizer crops*.

Cover crops help hold the soil and are recommended on slopes 3:1 or greater. Oats *Avena sativa*, annual rye *Lolium multiflorum** and winter wheat *Triticum aestivum* are excellent cover crops because they are inexpensive, easily established and not overly competitive.

Winter wheat nurse crop, planted with native seed in September. Photo taken in October.

Recommended Nurse Crops/Companion Crops (planted with the native seed) – per acre

Spring
- 1.5 bushels oats - or
- 1 bushel oats and 5 lb. annual rye

Summer
- 2 bushels oats - or
- 1 bushel oats and 10 lb. annual rye

Fall
- 30 lb. winter wheat

Recommended Temporary Seedings/Stabilizer Crops (native seeding to follow in the spring) – per acre

Summer
- 1 bushel oats plus 10 lb. annual rye and one of the following warm-season species:
  5 lb. piper sudan grass
  10 lb. millet (Japanese or Pearl varieties)
  30 lb. sorghum (grain or forage)

Fall
- 20 lb. annual rye - or
- 60 lb. winter wheat

Caution: For native plantings, winter wheat is preferred over winter rye. Winter rye* is taller, more persistent and possibly allelopathic, chemically inhibiting the growth of wildflowers. Do not seed piper sudan grass, millet or sorghum too heavily. One good rain can cause mass germination. Piper sudan may cause concern among landowners as it is sometimes confused with shatter cane.

*There are many kinds of rye: annual rye *Lolium multiflorum;* perennial rye *Lolium perenne* and winter rye, cereal rye and grain rye (all names for the same plant) *Secale cereale.*

Cover crop conversion chart

Species	Lbs. in a bushel	Seeds in an oz.	Seeding at 1 bushel/A results in:
Oats	32	910	10 seeds/ft.^{2}
Winter wheat	60	937	20 seeds/ft.^{2}
Annual rye	-	12,710	Seeding at 10 lb./A results in 46 seeds/ft.^{2}

Mixing Seed

Native seed can be ordered pre-mixed. If species come individually bagged, they will have to be mixed thoroughly. Mechanical seed mixers are available. Otherwise hand mix as follows:

- On a calm, dry day seed can be mixed outdoors on a smooth, concrete surface. Otherwise select a well-ventilated building with a hard, smooth floor.
- Wear dust mask and safety glasses.
- Prop the door open wide and turn on the exhaust fan.
- Measure out the seed with a scale and dump it in piles.
- Mix seed with scoop shovels.
- After mixing, put seed in trash cans for hauling to the site.
- Seed that won't be planted right away must be kept cool and dry.

Seeding Methods

There are three seeding methods: drill seeding, broadcasting and hydroseeding. Each has advantages and disadvantages.

A native seed drill is still the seeder-of-choice for many roadside managers. This one has been modified by the county; drag chain has been added to smooth over seeded area.

Drill Seeding

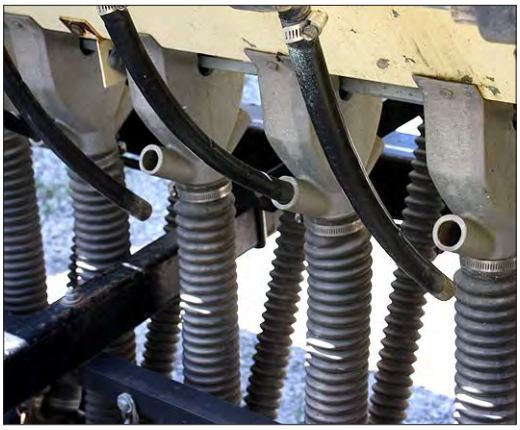
Seeding with a native grass drill is the preferred method on level rights-of-way. Drilling is a one-step process, and is quicker and cheaper than hydroseeding. Drills do a better job establishing native grasses and produce faster results overall.

Drills do not work well on slopes. At 3:1 or steeper, the drill will try to slide sideways causing the disk openers to dig in and bury the seed. Projects with silt fences present another challenge; maneuvering a tractor and drill around these fences is difficult.

Drill seeding tips

- Calibrate the drill in the shop and set the rate a little lighter than what you actually want. Bouncing over the ground, a drill set at 6.5 lb. to the acre might actually seed 8 lbs. to the acre.
- When planting very clean seed with an older drill, use a filler to slow it down. Bulk-harvested seed or fluffy little bluestem works well.
- For good seed distribution, use the small seed box for fine seed and the fluffy seed box for grasses, large forb seed and seed that hasn't been well-cleaned. Alternatively, sprinkle a portion of the forb seed on top of the other seed in the drill's middle hopper, then add more forbs every other round or two.
- Do not plant native seed deeper than ¼ in. Most native seed is small and lacks the energy to emerge if planted too deep.

- The trash plow attachment on a native grass drill should just scratch the surface. If it's making furrows, it's planting too deep.
- For uniform coverage, drill seed at a light rate and go over the area twice.
- Multiple passes packs the seed well and creates more rills that hold seed and interrupt water flow.
- To prevent seed from being buried too deep, disconnect the lower end of the drill's seed tubes. Some of the seed will land on the soil surface and not be buried in the furrow. Some people prefer to unhook only every other tube. Others unhook only the tubes coming from the small seed box.



Disconnecting every other tube from the small seed box allows seed to be scattered more naturally and prevents the smaller seed from being buried too deep.

Hydroseeding

Hydroseeding is ideal for bridge approaches, cleanouts, culverts and wet or steep slopes. In most cases, the entire project can be hydroseeded from the shoulder. Other hydroseeding advantages—hydromulch reduces soil erosion; the risk of seeding too deep is eliminated; colored mulch on the soil makes a positive impression on the public.

Filling the hydroseeder takes time, so drilling or broadcasting are usually quicker for larger projects. Other hydroseeding disadvantages—mulch is expensive and can double the cost of a seeding; the seeding rate is harder to control; hydroseeding is strictly a bare-ground application.

Top right: Ditch cleanouts can leave a steep foreslope. By angling the gun and using a concentrated stream, seed will be embedded in the slope. Bottom right: Hydroseeders can be very useful for challenging sites. Bottom left: Using a loader tractor to load mulch bales saves time and backs.

Hydroseeding tips

- It's best to seed after a rain, not just before. Seed and mulch stick better on moist soils. Some moisture is captured under the mulch. Mulch needs time to set up before it rains.
- Increase overall seeding rate by 25% to compensate for seed damaged going through hydroseeder mechanics and for seed that gets hung up in the mulch.
- The "shadow areas" behind larger dirt clods sometimes get no seed. For better coverage, try to seed in two passes, one from each direction. Seed lightly – so the seeding rate is not doubled – at 7 to 8 mph, with flow rate reduced.
- An 800-gallon hydroseeder is the minimum recommended size. A 1,500-gallon hydroseeder can cover 1/3 acre per load. With a machine of this size, seven 50-lb. bales, or 350 lb. of mulch per load, yields about 1,000 lb./acre.
- Seed the area farthest from the road first.
- On steep slopes, try to embed the seed by using a more concentrated stream and holding the gun at a sharper angle.
- For the sake of efficiency, most county roadside managers apply seed and mulch in one pass. The "two-pass" method – seed applied first, hydromulch to follow – results in better establishment since more seed is in direct contact with the soil.

An innovative 3-step method was used on this critical slope: 1) hydroseed with tack and paper mulch, 2) blow on straw, 3) hydromulch with more tack and paper mulch to "stick" the straw and seed.

Hydromulching rates:

- 1,000 lb./acre – a token amount to help carry the seed and show what area has been seeded
- 2,000 lb./acre – appropriate for most 3:1 slopes
- 3,000 lb./acre – very heavy rate for long, steep slopes

Broadcast seeding

Broadcast seeding is a viable option now that commercially available native seed is cleaner and less fluffy than it once was. When applied with broadcast seeding equipment, this debearded seed flows better and slings farther and truer than in the past.

Broadcast seeding tips

- Broadcasting finer-seeded species prevents them from getting buried under too much soil.
- For very clean seed, the Vicon™ broadcaster can be adjusted down to the "nth" degree. For fluffy seed just open the gate a lot wider.
- A broadcast seeder on a 3-point is more compact than a drill and easier to get in and out of ditches.
- Broadcasters can be backed up to silt fences to sling seed on both sides.

Broadcast seeding.

Hand seeding
Scattering seed by hand followed by light raking is very effective for smaller sites and prevents fine seed from being planted too deeply.

- To improve distribution, mix the seed with some kind of carrier. Sand is best. Kitty litter or oats are also used.
- Mix the seed and carrier in a bucket and scatter it over the site by hand.
- Many wet prairie species have fine seed and should be seeded this way.

Packing the seed
Packing seed tightly to the soil ensures a more consistent flow of moisture from the soil to the seed. The result is better germination and better seedling survival.

- Packing is most important after broadcast seeding, but is always beneficial.
- A 4-ft. cultipacker section on a 3-point is very effective and will go places the tractor and drill can't.

Cultipacking a broadcast seeding.

Converting Non-native Roadsides to Native

Occasionally a landowner will contact the county IRVM program to request a native planting adjacent to his/her property. If the site is conducive to a successful native planting, some counties accommodate these requests. Converting non-native vegetation to native requires eliminating the existing vegetation, usually by application of glyphosate. Cool-season grasses such as brome, fescue and bluegrass can be persistent and might require more than one application.

- Kill existing vegetation with a 2% solution of glyphosate in April or May.
- If thistles and other broadleaves are present, apply a Transline/Telar mix the fall prior to glyphosate in the spring.
- Apply the herbicide when existing vegetation is green and growing but no more than 12 in. tall.
- If there is still green grass after ten days, apply the herbicide a second time.
- Consider keeping the top 4 ft. of the foreslope unsprayed, leaving it stabilized with mowable, cool-season grasses.
- A native grass drill is most effective for planting into the dead stubble, disturbing the dead turf as little as possible while getting seed in direct contact with soil.
- Keep the entire planting mowed during the first growing season because weeds will likely be released once the existing cover has been destroyed.
- In subsequent years, spot-spray weeds as they appear.

Establishment mowing

During the first growing season, native seedlings remain small and can suffer losses due to competition by tall, thick weeds.

- Mow the planting three or four times during the first growing season.
- Don't wait until weeds are too tall.
- A mowing height of 4 in. is good but to avoid scalping, 8 in. is better.

Ditch bank and boom mowers with flail heads are useful for establishment and spot mowing.

Evaluating new plantings

First-year native seedlings are small, making them hard to find and even harder to identify. As a result, people often worry or assume the planting is a failure.

- If the site was drill-seeded, look for anything growing in rows.
- Seedling ID books are available. (See *Supplemental Material* in the Appendix.)
- If the success of a seeding is being challenged, hire a botanist to look for seedlings.
- Unless a planting is washed out by heavy rains, allow two full growing seasons before giving up and starting over.

Black-eyed Susans bloom in a young planting (far left). Most native species are slower to appear, establishing roots before above-ground growth becomes obvious.

A first-year seeding may look like the photo at left where weeds are taking advantage of moisture in the drill rows. Establishment mowing and patience are required.

Comments

Timing

Fall seeding works great unless there's a lot of snow that winter. Everything will wash away in the spring unless the area is flat. ***Joe Kooiker, Story County, 2006***

If a wet area needs to be traditionally seeded, wait until after freeze up.
Joe Kooiker, Story County, 2006

We begin dormant seeding in October once the 4" soil temperature reaches 50 degrees.
Jim Uthe, James Devig, Dallas County, 2010

I don't seed in September or October. I wait until November, then drill into a cover crop and mow the following spring. If weather conditions deteriorate in November, I can still seed in the spring.
Wes Gibbs, Jones County, 2011

I don't intentionally wait to frost seed. I might consider it, but only on flat areas in perfect conditions. Another time I might frost seed: If I've dormant seeded an area in the fall, I might go back in and frost seed over the top. Two types of stratification seem to produce better diversity.
Wes Gibbs, Jones County, 2011

Site Preparation

Watch out when preparing the seedbed. Working the soil too much promotes weeds and erosion.
Joe Kooiker, Story County, 2006

On hard, smooth ditch cleanouts, at the very least, try to rough it up. A small cultipacker on a 3-point works pretty well in most ditches. If nothing else, the corner of the cultipacker will dig and rip the ground and the tires will spin and the bottom of the tractor will scuff, creating a rougher surface where the seed can catch and hang on. ***Joe Kooiker, Story County, 2006***

For hydroseeding we prefer the site to be rough and a little soft. We seed immediately after the loader has left, with no additional seedbed preparation. The rough texture keeps the seed in place and the softness allows for better root penetration. However, for drill seeding, firmness is the most important factor. It is easy for seed to get buried too deep in soft seedbeds, either during or post planting.
Doug Sheeley, Dallas County, 2006

Cover Crops

Sometimes cover crops are as much for public perception as they are for erosion control. Engineers, farmers and people in general like to see something green. Weeds can be a good nurse crop too, if kept from getting too tall. ***Joe Kooiker, Story County, 2006***

The nurse crop can be added to the slurry in the second pass with good success. Wheat and oats are very difficult to keep in suspension in pure water, so it's better to include mulch in the second pass. ***Wes Gibbs, Jones County, 2010***

Unless soil has been aggressively ripped, or cultipacking occurs after seeding, oats and winter wheat do not perform well as nurse/cover crops when one-pass hydroseeding. We think ryes germinate best. We use annual rye when from April through September. Since annual rye will not overwinter as seed and needs sufficient growth to overwinter as a plant, we use grain rye from October through March. We also use pearl millet as a hydroseeding cover crop, if conditions warrant, and we may throw in a pound of timothy also – a fairly non-aggressive, cool-season perennial – to help in very steep areas. ***Jim Uthe, James Devig, Dallas County, 2010***

In addition to increasing our native grass rate on very steep slopes, we also may consider increasing our cover crop rate. Since grain rye exhibits some allelopathic tendencies, its use likely affects overall diversity. But as we've aleady said, diversity takes a back seat to stabilization on steep slopes. ***Jim Uthe, James Devig, Dallas County, 2010***

The majority of our regraded slopes are steep. I regularly use 2.5 bushels of oats, 6 lbs. of annual rye and 3 lbs. of timothy along with the permanent seed mix. This provides a better chance of stabilizing the slopes while the permanent seeding establishes, and I haven't noticed any detrimental effect to the planting's long-term success. ***Linn Reece, Hardin County, 2011***

On large, contracted projects we fertilize the cover crop to DOT specs; the flush of weeds has usually subsided by the time we plant natives in the fall or following spring. On smaller, in-house projects and ditch cleanouts we don't fertilize. I wouldn't recommend fertilizer with natives, but it does help cover crops planted in nutrient-deficient soils. ***Wes Gibbs, Jones County, 2011***

In typical Iowa soils, fertilizer and plant growth hormones aren't needed. However, we've used Finn's HydroMax along with starter fertilizers and various other amendments on steep slopes and channels with poor soil, and have had very good results. It's cheaper to quickly establish a cover crop than to spend the time and resources repairing or redoing a project. It's also good PR with the engineering staff and public to see a quick green-up. Again, we only use this practice on areas of very poor soil with a lot of erosion potential, or to protect a high-dollar project. ***Jim Uthe, Dallas County, 2011***

Seeding Methods

Vicon fertilizer spreaders work great for broadcast seeding native seed. They can go on the tractor, on the trailer, and down the road with a one-ton pickup. ***Joe Kooiker, Story County, 2006***

When hydroseeding try to carry enough mulch with you to finish the project. We lightly disk the seedbed before hydroseeding, if possible; cultipack after we seed; then apply mulch (two-pass method). Hydroseeding works well with combine-run seed. ***Joe Kooiker, Story County, 2006***

Don't trust your drill to meter your seed. Know your acreage and equally distribute the seed. ***Wes Gibbs, Jones County, 2011***

When filling a hydroseeder from a creek, know your source. Don't fill from an area with invasives (e.g., purple loosestrife). ***Jim Uthe, James Devig, Dallas County, 2010***

Filling near the site with a trash pump has drastically improved the efficiency of the process. We mounted the pump on the seeder, so we simply drop a fill line into the water and turn on the pump.
Josh Brandt, Cerro Gordo County, 2010

When hydroseeding, be sure to mix seed thoroughly in the water, both initially and periodically during application. Our Finn hydroseeder can reverse the mechanical agitation, which is helpful.
Jim Uthe, James Devig, Dallas County, 2010

We have better germination with lighter hydromulch rates (400-500 lbs./acre).
Dave Sedivec, Chickasaw County, 2010

There's s been some concern about high mulch rates affecting seed germination. I don't think that's an issue with large grass seeds, and even small seeds aren't affected when dormant seeding with a high mulch rate since the mulch softens and breaks down over the winter. The seed can't germinate if it's washed away, so use enough mulch to get the job done right.
Jim Uthe, James Devig, Dallas County, 2010

When mixing seed, we mix 10 acres worth of the fluffy grass (sideoats, big blue, Indian, little blue and Canada wild rye) and put it in large, plastic garbage cans. Then we mix 10 acres worth of the forbs and the two slick grass seeds (rough dropseed and switch) and put that in a large Rubbermaid tote. This year our fluffy grass rate is 12.2 lbs/acre and our forb and slick seed is 4.6 lbs/acre.

When hydroseeding, we bump these rates an extra 30 to 50% at times depending upon site conditions and current climatic factors. We pretty much always seed with mulch and we typically use 1500 lbs. of a blended mulch per acre. Our 3300-gallon unit seeds about 0.9 acres pretty well with 1350 lbs. of mulch in it (3600 gal. of material per acre). Some people I know put 1500 lbs. in a 3300 gallon seeder and seed a full acre, but we always seem to run a little short doing it that way.
Jim Uthe, Dallas County, 2011

When hydroseeding, you initially have to know how much area you are covering with a full load. With our Finn T-90, I cover a third of an acre per load. That may be more than is recommended for that size machine, but it means fewer loads per job and quicker to finish. With our 22-foot wide ROWs (average), we travel 660 feet to make that 1/3 of an acre. With practice you can become pretty accurate — arriving at 660 feet with an empty hydroseeder. If we use UNI's recommended rates, then big bluestem at 1.5 lbs per acre, for example, uses 0.5 lbs per load. We weigh out the amount of each species needed for a 1/3 of an acre and put it in one bag ahead of time. Then we can just dump the bag in each load. This holds true for the nurse and temporary crops as well.
Linn Reece, Hardin County, 2011

4 EROSION CONTROL

Erosion control protects water quality, maintains the structural integrity of the roadway, protects germinating seed, and helps counties comply with NPDES Phase II regulations. It is among the most important goals of an IRVM program. Permanent vegetation is the long-term solution, but short-term erosion control is necessary to protect exposed soil while vegetation matures.

Types of erosion
Soil erosion can occur by a number of processes. Those of greatest concern to a roadside manager are **splash**, **sheet** and **rill** erosion on slopes, and **channel** erosion in concentrated flow areas.

Splash erosion occurs when raindrops dislodge exposed soil particles. These particles settle in soil pores and when dry, form a crust, reducing infiltration during subsequent rains.

Sheet erosion occurs in heavier rains on uniformly smooth soil surfaces. Dislodged particles become suspended and are transported downslope.

Rill erosion occurs when slight differences in soil surface elevation cause runoff to concentrate and form a pattern of cuts or rills. It is more likely to occur than sheet erosion since slopes are rarely uniformly smooth.

Channel erosion occurs in concentrated flow areas and is caused by downward scour due to flow shear stress. Many, if not all roadsides are conduits for concentrated flow.

Planning for erosion control
Erosion control objectives should be considered in the planning stage of each roadside project. Many factors affect a site's erosion potential. Some also affect how quickly vegetation will establish and provide stabilization. The following interconnected factors should be analyzed to determine what, if any, erosion control practices are necessary:

- Time of year (How long will soil be exposed?)
- Soil type and fertility
- Slope length, grade and aspect
- Off-site surface flow onto project area
- Type of seed mix (Warm season establishes slower than cool season.)
- Weather forecast

Erosion control and IRVM

Some IRVM programs will be more involved in erosion control than others. Sediment control and long-term erosion control may be the responsibility of other departments or contracted out.

All IRVM programs will be responsible for short-term soil protection provided by proper site preparation, nurse/stabilizer crops and mulches.

Other considerations: the consequences of failure and the presence of sensitive areas (e.g., wetlands, sensitive waterways and critical habitats for threatened and endangered species).

EROSION CONTROL

General short- and long-term erosion control techniques are outlined below. The erosion control industry has many useful websites with up-to-date technical specifications and guidelines. A list is provided at the end of the chapter. Take advantage of these resources and other educational opportunities to stay abreast of this rapidly evolving industry.

Soil Preparation

Strike a balance between an ideal seedbed and maximum erosion control. Firm, friable soil surfaces – recommended for seeding – can be susceptible to erosion. Loose, rough soil surfaces provide better infiltration and slow runoff.

Surface roughening practices, such as **directional tracking** and **grooving,** slow runoff by creating depressions or grooves perpendicular to the flow. On steep slopes, these practices must be used in conjunction with other methods, preferably hydroseeding.

Directional tracking
Driving a bulldozer or other tracked vehicle up and down a slope leaves depressions perpendicular to the slope. (Driving a tracked vehicle *across* the slope can increase erosion.) Tracking may not be appropriate on clayey soil since compaction can inhibit vegetation establishment, and severe compaction can even prevent no-till drills from penetrating the soil. Concerns regarding compaction decrease when hydroseeding or broadcasting during the dormant season, since freezing and thawing will loosen the soil.

Grooving
Pulling a disk or ripper behind a tractor or dozer, or back-dragging a toothed bucket with a loader across a slope creates a series of ridges and grooves. Grooving can be more effective than tracking because the depressions are usually deeper and the soil is left in a looser state. Many implements can be used.

SUDAS (Statewide Urban Design and Specifications) specifies grooves be no more than 15 in. apart and 3 in. deep, though groove depth is subject to debate. Deep grooves improve erosion control, but increase the likelihood of seed becoming buried too deeply to germinate. Seeding method will help determine appropriate groove depth. One-step hydroseeding is best over deeper grooves since mulch keeps seed near the surface. If seed is not incorporated in a slurry when planted, lighter grooving is recommended.

Pulling a ripper perpendicular to the slope creates grooves that slow runoff. When followed by hydroseeding, vegetation germinates and grows in the grooves, creating a drill-row appearance.

Mulch

Mulch helps prevent splash erosion and holds seed in place by absorbing rainfall impact and binding soil particles together. Mulching is accomplished by blowing on straw or by hydromulching.

Straw

Dry cereal straw – free of noxious weed seed – can be applied alone or on top of seed to provide short-term erosion protection, conserve moisture and suppress weeds. Typically oats or wheat straw is used – blown on at a rate of 1 to 1½ tons per acre. Straw applied evenly at the correct rate will allow approximately 50% of the soil to be visible. If applied too heavily, seed germination may be affected. Some bale processors can be adjusted to make shorter or longer mulch – longer is better.

To keep straw mulch on site, it must be crimped or tacked in place. Areas accessible to ground-driven equipment can be crimped. Crimpers (a.k.a. mulch tuckers or mulch discs) are mounted on a 3-point and pulled with a front-wheel assist tractor. Test runs are necessary to ensure the crimper wheels go in to the soil at least three inches – enough to anchor the straw. Properly anchored straw mulch will stand up straight and look similar to oats mowed high.

Tacking is accomplished by adding tackifier to water in a hydroseeder and applying evenly until the straw is wet, but not running off. This dries and acts as a glue to hold the straw in place. Tackifier rates vary with brand and are provided on the bottle in lbs. per acre. If too much tack is added, the mixture will get slimy and prevent the pump from priming.

Some IRVM programs use prairie hay – harvested from plots or plantings – in place of straw mulch. Application method and rates are similar to straw, though rates may vary depending on the dominant species in the hay. Fewer bales will be necessary because the hay weighs more than straw.

After seeding, large- or small-bale processors are used to blow straw mulch on site. The mulch is then crimped or tacked in place, to keep it on site while vegetation emerges. (Crimper image courtesy Burchland Manufacturing.)

Hydromulch

Hydromulches are applied with or on top of seed to conserve soil moisture and, depending on type, prevent splash, sheet or rill erosion. None are suitable to withstand the shear stress of concentrated-flow situations.

Common types of hydromulch

Cellulose (paper)

Made from recycled newspaper, magazines and corrugated cardboard, cellulose is the least expensive hydromulch. Its advantages over wood fiber mulch include: greater water retention, quicker mixing and better pumpability. Cellulose may be the least effective at controlling erosion since it does not have long, interlocking fibers. Be aware of the "paper mache" effect which reduces moisture and airflow to seed, and occurs when cellulose is applied too heavily or with too much tackifier.

Wood fiber

Wood fiber mulch is produced from milled wood, typically aspen. It is more expensive than cellulose and does not hold as much moisture, but it has more loft and the interlocking fibers provide greater erosion control.

Wood/cellulose blend

Blended mulch usually consists of 50-70% wood fiber and 30-50% paper products. It falls in the middle of the two previous mulches in terms of cost, water retention, pumpability and erosion protection.

BFM (Bonded Fiber Matrix)

BFM is a wood fiber mulch – usually with elongated fibers – containing various adhesives, binders and synthetic fibers. BFM mulches retain their strength much longer than traditional mulches.

MBFM (Mechanically Bonded Fiber Matrix) and FGM (Flexible Growth Media)

These mulches contain elongated wood fibers and crimped synthetic fibers along with various adhesives and binders. The crimped fibers provide a strong, mechanical, fiber-fiber-soil bond. No cure time is required to provide erosion protection.

Hydromulch application

Hydromulch is mixed with water and often a tackifier in a truck- or trailer-mounted tank. Spraying the slurry on to the site is called "hydromulching." When "hydroseeding," seed and amendments are added to the slurry. The terms are often used interchangeably. Recommended hydromulching rates are shown in *Table 1* (page 39) and discussed in Chapter 3 – Seeding.

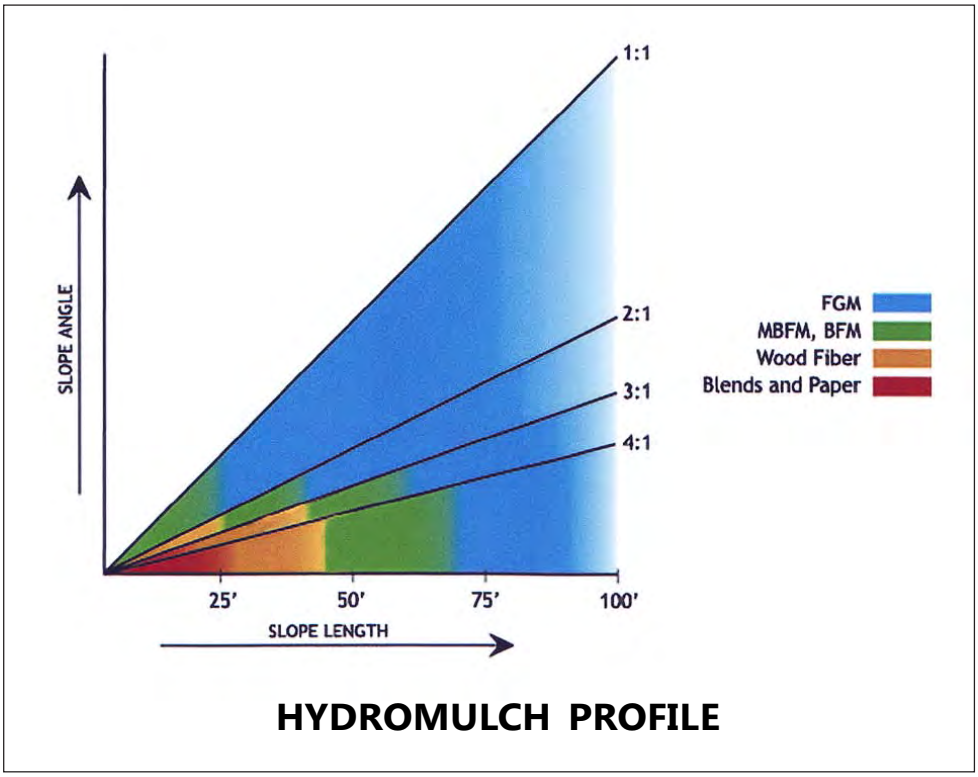
Tackifiers bind mulch fibers to each other and to the soil, enhancing erosion protection. Tackifiers can be purchased separately or be pre-blended in the mulch. Organic and synthetic tackifiers are available. All products have different recommended rates. See manufacturer recommendations before application.

Tackifying agents are preblended in BFM, MBFM and FGM products and undergo a chemical process known as "cross-linking" which prevents rainfall from rewetting and dissolving the tackifier after it is applied.

Amendments are added to the slurry to accelerate seed germination and establishment, and improve poor soils. Amendments include water soluble fertilizer, water-storing polymers and plant growth stimulants. Refer to the manufacturer for recommended rates. Peat moss and compost screenings can also be added as a soil amendment, though little research exists on rates.

Synthetic fibers can be added as an amendment to increase the mechanical bond of traditional wood fiber and blended mulches.

Figure 1



(Adapted from www.landandwater.com)

Compost Blanket

Typically used on poor soil, a compost blanket is a 1-4 in. layer of compost applied with a blower truck. The compost is a blend of coarse and fine material. If seed is applied with the blanket, the layer should not exceed 2 in.; establishing roots may not penetrate the underlying soil if the blanket is deeper. Be sure the compost is well-cured; if applied while still "hot," vegetation may not establish.

Compost blanket application. (Photo courtesy Soil-Tek)

A compost blanket should not be used where overland flow is expected. The blanket will absorb rainfall, but overland flow can erode the compost. If the blanket must be used in areas with overland flow, till in the compost.

When applied correctly, compost blankets are very effective at preventing erosion and promoting seed growth. Specialized equipment is necessary to properly apply compost blankets, so a contractor is typically hired. Due to the expense, a guarantee should be requested to ensure the job is done correctly.

Rolled Erosion Control Products (RECPs)

RECPs are arguably the best way to stabilize most channel areas. They are also used to stabilize slopes. Because RECPs need vegetation to function properly, site conditions must be conducive to vegetation establishment. In extremely poor soils or deep shade, riprap or erosion stone may be the best option. Temporary and permanent rolled products are available.

(Photo courtesy Laurie Honnigford)

Manufacturers of RECPs provide specs for their products online. Most manufacturers also provide software to help determine the appropriate product for a given site. A list of virtually all RECPs on the market and their specifications is in the Geosynthetics Specifers Guide.

Types of RECPs

Erosion control blankets (ECBs)

Erosion control blankets are *temporary, degradable*, rolled products made of natural or polymer fibers mechanically, structurally or chemically bound together to form a continuous matrix. Blankets are usually classified as **netless**, **single-net** or **double-net**.

Netless blankets consist of fibers stitched together with a biodegradable thread. Because there is no net, this product is typically used in intensively mowed areas and areas where animals could become entangled in netted products.

Single- and double-net blankets consist of one or two polymer or jute nettings interwoven with natural fibers – typically straw, coir (coconut) and/or excelsior. In general, netless and single-net are used on slopes or in low-flow channels. Double-net can be used on slopes and in higher-flow channels.

Straw ECB with biodegradable jute netting (left) and excelsior ECB with photodegradable synthetic netting (center). Netting and fiber components, along with site conditions, determine ECB longevity. TRMs (right) provide permanent reinforcement with a matrix of UV-stabilized, synthetic fibers and netting. Level of reinforcement is determined by material and product weight. (Photos courtesy Western Excelsior)

Turf reinforcement mat (TRMs)

TRMs are *permanent, non-degradable*, rolled products made of synthetic materials. These three-dimensional mats provide immediate erosion protection, enhance vegetation establishment and offer long-term functionality by permanently reinforcing vegetation. TRMs are typically used in high-flow ditch channels, and on very steep slopes where unreinforced vegetation may not provide adequate erosion protection.

SUDAS classifies TRMs by material and by their performance in channel and slope applications. Refer to *Table 1* for more information.

Selecting the appropriate RECP

Slope applications

Manufacturers' general application guidelines are the easiest way to select a product. A link to an example of these guidelines is provided here. Slope length and grade are used as criteria. Product longevity (determined primarily by material weight) must also be considered when using degradable products. Time of year, soil fertility, aspect, seed mix and other factors affect how quickly vegetation establishes. A product may be appropriate for a specific slope length and grade, but if installed over a seeding in poor soil, it may deteriorate before vegetation establishment.

Manufacturer software is also used to select products for slope protection. Links to examples are provided below. Slope length and grade, surface condition of the soil and the soil erodibility (K) factor for the soil type (found in the NRCS soil survey for each county) are entered in the program which then suggests multiple appropriate products. Growing conditions and seed mixes determine the appropriate functional longevity.

Software examples:
North American Green • Profile Products • American Excelsior

Check Dams

Check dams should be constructed of *clean* rock, permeable plastic berms or similar products. Unlike silt fence, check dams do not cause water to dam up; they let water pass through – slowing its velocity and dissipating its energy.

Sedimentation can occur on the upstream side. If it becomes too great the check dam will function as a waterfall and the project may begin to fail. Monitor and excavate the upstream side if necessary.

Plastic berms should not be placed in areas susceptible to filling with debris (e.g., corn stubble from a field waterway). One heavy rain can cause these berms to fill with stubble, creating a dam.

Improper check dam design is not uncommon and can cause project failure. Follow current design specs, and account for the individual characteristics of each site.

A permeable plastic berm check dam in channel after vegetation has begun to establish.

Erosion and sediment control web sites

Iowa Construction Site Erosion Control Manual

SUDAS Design Manual – Chapter 7: Erosion and Sediment Control

Soil Erosion and Hydroseeding

International Association of Hydroseeding Professionals (IAHP) forum

Mat, Inc. Erosion Control Products

Central Fiber, Corp.

Profile Erosion Control Products

Finn Corporation – Mulch products

Verdyol Biotic Earth Products

Kincaid Equipment Hydroseeders and Straw Blowers

Bowie Industries Hydromulchers

Finn Corporation - Hydroseeders

Epic Manufacturing

TurboTurf Hydroseeding

Tensar North American Green

American Excelsior

Western Excelsior Erosion and Sediment Control Products

Nilex

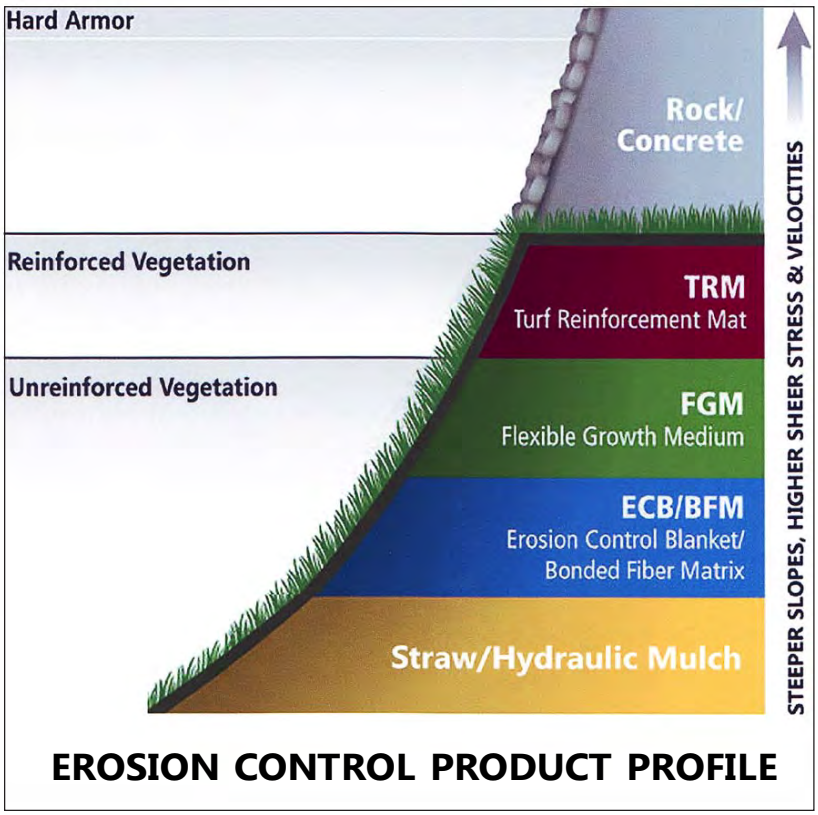
Channel applications

When stabilizing a concentrated flow area with temporary RECPs, estimate the amount of flow and time it will take for vegetation to establish. Then use manufacturer specs to select a blanket with the appropriate strength and longevity.

For large-scale projects, especially in high-flow situations, further analysis may be necessary:

1. Determine channel dimensions, including width and grade of the channel bed and slopes of each side of the channel.
2. Determine the amount of flow, in cubic feet per second (CFS). Flow determination for a given rain event can be done with complex mathematical formulas (performed by engineering staff) or by observing the channel's watershed and making an educated guess. When protecting channels at culvert outlets, design protection to withstand maximum discharge.
3. Consider the consequences of failure to decide whether the project requires protection against a two-year storm, five-year storm, ten-year storm, etc. According to CPESC (Certified Professional in Erosion and Sediment Control) guidelines, when using permanent RECPs (TRMs), projects are usually designed to withstand the ten-year frequency, 24-hour duration rainfall event. This is about 4 in. in northern Iowa and 5 in. in the southern part of the state.
4. Enter channel dimensions and flow into the manufacturer's software, available at their website, to determine an appropriate blanket.

Figure 2



(Adapted from www.landandwater.com)

Installing RECPs

Erosion control blanket installation

- Provide good blanket-to-soil contact by creating a smooth soil surface.
- Trench the top of the blanket to a depth of 6 in. and staple at the bottom of the trench. Any blanket overlap should be at least 6 in.
- Refer to the manufacturer's specs for recommended stapling patterns. In the absence of instructions, staple in a staggered pattern using 3-ft. centers on a slope and 2-ft. centers on a channel.
- In channel applications, center a blanket in the channel bottom to avoid having a seam under the area of maximum flow. At 25-33 ft. intervals, place a check strip of staples 2-4 in. apart across the blanket.
- Install additional staples in uneven ground to ensure good soil contact especially in low points.

RECPs are often maintenance-free after vegetation has established. Until then, inspect after every runoff event, adding staples where erosion has occurred. Routine maintenance is easier than repairing and reseeding the large ruts and gullies that can form under improperly installed or maintained RECPs.

When installing ECBs, trench the top of the blanket 6 in. and staple at the bottom of the trench. Follow manufacturer specs for stapling patterns. Tuck the downstream blanket at least 6 in. under the upstream blanket to prevent flow from getting under the blanket.

TRM installation

- When used in areas saturated for long durations, provide subsurface drainage to prevent erosion under the mat.
- Anchor mats with 6 in. staples. Use 8 in. staples or stakes in high-flow and loose-soil situations.
- For slope stabilizations, anchor mats with high performance duckbill anchors or ScourStop anchors.
- Seed should be drilled or hydroseeded (not broadcast) to prevent small seed from floating up through holes in the mat and washing away during high-flow events.

- In high-flow situations, BFMs can be used under the mat. Laying sod underneath will provide instant erosion control.
- In slope stabilizations, soil can be placed over the mats. In concentrated flow areas, the top layer of soil will wash away unless straw or excelsior blanket is placed on top.
- TRMs can be infilled with BFMs and FGMs in both channel and slope applications.


Left: TRM in use with ECB and ditch check to provide both erosion and sediment control. Right: A lightweight TRM (green) is used where a moderate-flow channel becomes steep, while a heavyweight TRM (brown) protects against very high flow from a 36 in. culvert.

Other

Flow Transition Mats

Flow transition mats are a "green" alternative for riprap or concrete in the transition area between flow outlets and channel flow. The semi-rigid, plastic mats – approximately 4 ft. x 4 ft. x ½ in. – are designed with holes which allow vegetation to grow. The mats are installed on top of a TRM in areas of high scour, such as culvert outlets. Flow transition mats can provide better protection than riprap and installation is an easy, one-man job.

- When placing transition mats over fill, make sure area is well-compacted to prevent failure from settling.
- Use subsurface drainage in areas with long durations of saturation.
- For best results, place sod underneath the TRM.
- If not using sod, high-flow events can cause erosion before vegetation establishes. To help minimize erosion, install a staple check strip in the TRM directly downstream of the transition mat.
- Check mats after every runoff event during the first two seasons to make sure anchors are still tight.

Flow transition mat, placed at culvert outlet over TRM on a prepared seedbed.

Vegetation grows through holes in the mat.

Table 1: **EROSION CONTROL OVERVIEW**

	Max. slope					Benefits	Limitations	Rate/ A
	4:1	3:1	2.5:1	2:1	1.5:1			
Soil Preparation*								
Directional Tracking	●	●	●	●	●	• Can be used to help prep soils on very steep slopes • Can use the same equipment being used to complete construction	• More time consuming than grooving • Can excessively compact soil, especially heavy clay soils • Need access to a tracked vehicle	n/a
Grooving	●	●	●			• More erosion protection than directional tracking • Less soil compaction than directional tracking	• More risk involved for operator on steep slopes since machine has to be driven along slope contours	n/a
Mulch								
Straw								
Tacked	●	●	●	●	●	• Can be applied on slopes and small projects inaccessible to equipment	• Time-consuming for large projects.	2000 lb
Crimped	●	●				• Good for large projects	• Not practical for slopes greater than 3:1	1500-2000 lb
Hydromulch								
Paper	●					• Most economical hydromulch • Flows through machine and hoses better than other mulches	• Provides least amount of erosion control • Can "paper mache" if applied too heavily or with too much tackifier, hampering seed germination	1500-2000 lb
Wood	●	●	●			• Wood fibers interlock better than paper mulch	• More expensive than paper mulch	1500-3000 lb
Wood/ Paper blend	●	●				• Pumps better than 100% wood • More economical than 100% wood	• Less erosion protection than 100% wood	1500-3000 lb
BFM**	●	●	●	●	●	• Longer fibers protect better than traditional wood fiber mulch • Contains cross-linking tackifying agents • Lasts longer than wood or paper mulch	• Needs to dry and cure to provide protection • Requires more water to flow through machine properly	3000-4000 lb
MBFM**	●	●	●	●	●	• Immediate erosion protection, even in light rains • Contains cross-linking tackifying agents • Lasts longer than wood or paper mulch	• Most expensive type of hydromulch • Requires more water to flow through machine properly	3000-4000 lb
Compost blanket								
	●	●	●	●	●	• Enhances seed germination and plant growth • Excellent at absorbing and holding rainfall.	• Water may get under blanket if not applied 5-10 feet back from the top of the slope • May rill during severe storm events • Not many available contractors • Can kill seed if compost is not fully cured	1-4" deep

Rolled Erosion Control Products (RECPs)				
Erosion Control Blankets – Type of netting, number of nets and weight of material all contribute to performance				
	Typical Applications	**Benefits**	**Limitations**	**Longevity**
Netless Excelsior	3:1 or flatter slopes Very low-flow channels in sensitive areas	• Has no net to entangle wildlife or get caught in mowing equipment	• Limited to gentle slopes and low-flow channels	12 months
Straw	2:1 or flatter slopes Low-flow channels	• Best for seed germination • Least costly type of blanket	• Does not conform well to uneven surfaces • Most prone to "tenting"	3-12 months
Straw/Coir blend	1:1 or flatter slopes Low-flow channels	• Good seed germination • More longevity than straw alone	• Does not conform well to uneven surfaces • Prone to "tenting" • More costly than 100% straw and excelsior	12-24 months
Coir	1:1 slopes Medium to high-flow channels	• Excellent longevity • Can be used in high-flow channels if vegetation will establish quickly	• More costly than straw and excelsior	36 months
Excelsior	3:1 to 1:1 slopes Low to high-flow channels	• Many styles and weights available • Conforms well to irregular surfaces • Good water absorption	• More costly than straw	12-36 months***
Turf Reinforcement Mats (TRMs)				
Type 1	1:1 or flatter slopes Shear stresses ≤ 7 lbs/ft²	• Provides for more infiltration and natural aesthetics than rip rap or concrete • Least costly type of TRM	• Least resistant to UV degradation of all TRMs • Ineffective in areas not conducive to vegetation (i.e. areas with heavy shade or very poor soil) • Destroyed by prescribed fires	Permanent
Type 2	1:1 or flatter slopes Shear stresses ≤ 10 lbs/ft²	• Provides for more infiltration and natural aesthetics than rip rap or concrete	• Ineffective in areas not conducive to vegetation • Destroyed by prescribed fires	Permanent
Type 3	1:1 or flatter slopes Shear stresses ≤ 12 lbs/ft²	• Provides for more infiltration and natural aesthetics than rip rap or concrete	• Ineffective in areas not conducive to vegetation • Destroyed by prescribed fires	Permanent
Type 4	1:1 or flatter slopes Shear stresses ≤ 15 lbs/ft²	• Provides for more infiltration and natural aesthetics than rip rap or concrete • Most resistant to UV degradation of all TRMs	• Most costly TRM • Ineffective in areas not conducive to vegetation • Destroyed by prescribed fires	Permanent
Other				
Flow Transition Mat	Culvert outlets	• Allows more infiltration and provides a more natural aesthetic than riprap or concrete. • Can be easily installed by one person	• Needs to be installed on top of a TRM • Performs best when installed with sod • Needs to be monitored after every storm event until stabilized	Permanent

* Soil preparation methods are not stand-alone practices. To obtain desired results on steeper slopes, directional tracking and grooving must be used in conjunction with other methods, preferably hydroseeding.

** Used on 3:1 and flatter slopes when slope length exceeds 40-50 ft. See *Figure 1*.

*** Performance/longevity determined by length of fibers in addition to weight and netting characteristics.

SEDIMENT CONTROL

Containing eroded soil on the project site will be the responsibility of some IRVM programs. Basic sediment control products likely to be used on county rights-of-way are described below.

Wattles, Sediment Logs and Filter Socks

Wattles and sediment logs are tubes of straw, coir or excelsior fibers encased in burlap or degradable plastic netting and anchored by wooden stakes. Both filter sediment and slow water flow. Wattles and logs containing densely packed material – especially straw – are good as slope interrupters. Excelsior logs are more porous and less likely to float, so are better suited for ditch checks. Both are good for perimeter applications and inlet protection.

Filter socks are degradable tubes filled with compost, generally used for perimeter control or at intervals along a slope to capture sheet flow. To enhance sediment control, polyacrylamide (PAM) may be added to the compost. PAM captures clay particles creating cleaner runoff.

Wattles, logs and filter socks are usually easy to install and can be put on bare soil or over erosion control blankets.

Excelsior sediment log over excelsior blanket (top). Filter socks (bottom) conform well to soil, reducing the potential for rills to form under the sock.

Silt Fence

Silt fences are geotextile barriers trenched in to the ground and supported by posts. They are useful on perimeters and in channels with relatively low flow. Silt fences filter out small amounts of sediment as runoff passes through the fabric. They need to be kept clean to function properly and must be removed after final stabilization, but are easy to install and relatively low cost.

This silt fence was not backfilled properly and was placed in a channel in which the flow was too high.

Silt fences are not effective in high-volume flows and should not be used as a check dam. During moderate or heavy rains, a silt fence check dam will concentrate water from the entire channel, along with the water's energy. This concentration either goes around the outside of the fence or over the top at the lowest point. It can also go underneath the fence, causing erosion.

Silt fences are ineffective when improperly installed, and improper installation is common. To avoid the problems inherent with these practices, follow up-to-date specifications such as those found here:

Iowa SUDAS • Iowa DOT

Check Dams

Check dams should be constructed of *clean* rock, permeable plastic berms or similar products. Unlike silt fence, check dams do not cause water to dam up; they let water pass through – slowing its velocity and dissipating its energy.

Sedimentation can occur on the upstream side. If it becomes too great the check dam will function as a waterfall and the project may begin to fail. Monitor and excavate the upstream side if necessary.

Plastic berms should not be placed in areas susceptible to filling with debris (e.g., corn stubble from a field waterway). One heavy rain can cause these berms to fill with stubble, creating a dam.

Improper check dam design is not uncommon and can cause project failure. Follow current design specs, and account for the individual characteristics of each site.

A permeable plastic berm check dam in channel after vegetation has begun to establish.

Erosion and sediment control web sites

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Soil Erosion and Hydroseeding

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Mat, Inc. Erosion Control Products

Central Fiber, Corp.

Profile Erosion Control Products

Finn Corporation – Mulch products

Verdyol Biotic Earth Products

Kincaid Equipment Hydroseeders and Straw Blowers

Bowie Industries Hydromulchers

Finn Corporation - Hydroseeders

Epic Manufacturing

TurboTurf Hydroseeding

Tensar North American Green

American Excelsior

Western Excelsior Erosion and Sediment Control Products

Nilex

Comments

Straw mulch

We use wheat straw. It seems to be longer than oats straw and is typically the same price. I have worked with a local contractor who brings up Kansas wheat straw. We have also used Iowa Certified weed seed free straw at a little higher price. ***Wes Gibbs, Jones County, 2011***

With oats or wheat straw, I've used seed-bearing stalks to my advantage; it can work as a good cover crop. ***Ben Hoskinson, Mahaska County, 2011***

We always use 1.5 tons/acre of straw mulch. ***Ole Skaar, Roadside Development, IaDOT, 2011***

To apply straw mulch, I use a small bale blower with a gas motor. It chops up the bales. It's labor intensive and you have to remove the strings from each bale, so I usually only tackle small projects with it. The big round bale blowers (I don't have one) are less labor intensive and can cover a lot more area in less time but you have to have a mode of transportation for the bales and a large tractor to run it. I generally mulch at 1000 to 1500 lbs. per acre. ***Ben Hoskinson, Mahaska County, 2011***

We use an agricultural-type bale processor (no cannon) which can be a little sporadic on the rate at which it discharges. I don't insist on 1.5 T per acre if it looks like we are getting adequate coverage, but if it takes 1.5 T to get the job done, that's what we do. Just be sure you aren't blanketing over your seed. You should be able to see the ground through the mulch. ***Wes Gibbs, Jones County, 2011***

Our mulch tucker / cultipacker combo is 8 ft. wide and weighs 1600 lbs. We pull it with a 95 HP tractor – you might be able to go a little smaller as long as you have sufficient weight in front to balance it when in the "up" position. ***Wes Gibbs, Jones County, 2011***

If harvested in the fall just after the seed heads have matured, prairie hay bales will carry enough seed to plant a new site. Some seed supplement may need to be used. I think prairie hay works better than straw. It is just reedy enough that it lays out and kind of locks together. Straw is a lot lighter and doesn't lay down as well. ***Ben Hoskinson, Mahaska County, 2011***

We have a couple organic farmers in the county. When I need straw, I buy it from them. They usually have a field in their rotational plan that will be in oats. I support the concept and like to help them in this small way. ***Linn Reece, Hardin County, 2011***

Hydromulch

An important factor that can get overlooked when dealing with sheet erosion is the additional overland flow that may be coming from the roadway. This can really affect hydroseeded areas, and increased rates of hydromulch may be needed. This doesn't seem to be an issue when using blankets – which makes sense since blankets are appropriate for protection against channelized flow.
Jim Uthe/James Devig, Dallas County, 2010

I use a wood/paper blend which I think works the best. The wood I've used by itself doesn't have enough substance. I also use FGMs or BFMs as a supplement to the wood/paper or as a stand alone.
Ben Hoskinson, Mahaska County, 2010

In an 1100-gallon load of tack, I like to add 2-3 bales of hydromulch, preferably wood fiber. The stringier the better. This seems to act as an additional binder and the dye helps you keep track of where you are spraying. I like to get out and visually inspect the treated areas to make sure things are sticking together. ***Wes Gibbs, Jones County, 2011***

SUDAS section 7E-5 deals with mulching to prevent sheet erosion, but I feel they are overly cautious. For instance they don't recommend hydromulching on slopes steeper than 6:1. I recommend looking at manufacturer specs for available products. ***Jim Uthe, Dallas County, 2011***

Rolled erosion control products

We do not use straw or straw/coir blankets in channels. Those materials don't absorb water like excelsior, so the blankets float if rain causes any flow. You might get them to work with sediment logs or lots of staples, but that isn't cost effective. Nothing beats good wood excelsior.
Ole Skaar, Roadside Development, IaDOT, 2011

I had heard at one time that forbs germinate better under straw than excelsior, but I'm starting to become a skeptic on that claim. For instance, I just inspected a project where we used Curlex-2 and there were just as many partridge pea seedlings in the blanketed areas.
Jim Uthe, Dallas County, 2011

If you're doing a lot of RECP installations, get a staple gun. It's worth the money! And if you need to cover a lot of surface area, I suggest the 16 ft. rolls (vs. the more common 8 ft. rolls). They're still fairly easy to handle and they cut your installation time and labor almost in half.
Wes Gibbs, Jones County, 2011

TRMS can stabilize very steep slopes, but in a typical county roadside setting it may be cheaper to buy more right-of-way, grade it to a gentler slope, and stabilize by hydroseeding or seeding/mulching.
Jim Uthe, Dallas County, 2011

We used double-net, straw/coconut blankets for concentrated flow areas with success, but due to the cost we're switching to double-net straw. They seem to allow just as good germination as the straw/coconut blend and are almost $20 cheaper per 100 ft. roll. They seem to provide adequate protection in a typical ditch bottom, but don't last as long.

Single-net straw blankets are available, but they only work in low-flow channels and are much more difficult to unroll than double-net. Double-nets are only about $7-10 more.
Jim Uthe/James Devig, Dallas County, 2010

Other

ScourStop can be used as a riprap alternative for channel protection if flow occurs only during larger rain events. The channel needs to dry out at times so vegetation can establish.
Ole Skaar, Roadside Development, IaDOT, 2011

Sediment Control

If a rain event is relatively small, silt fences will function properly. But small rain events typically cause little to no erosion. Silt fences may be good for PR but they create a point of failure for the project. A roadside is essentially a headwater stream. Stream dynamics show that flow = area * velocity. When the water from a flat, six-foot wide channel is concentrated into a width of typically less than a foot at the low point of a silt fence, the water's velocity increases substantially, thus erosion is caused instead of prevented. ***Jim Uthe, Dallas County, 2011***

Rock check dams should mostly be below ground. The "waterfall" problems can be eliminated if the check dam doesn't extend more than 3-4" above ground. ***Wes Gibbs, Jones County, 2011***

5 WEED CONTROL

Iowa Code section 317.11 states: *The county boards of supervisors and the state department of transportation shall control noxious weeds growing on the roads under their jurisdiction. Spraying for control of noxious weeds shall be limited to those circumstances when it is not practical to mow or otherwise control the noxious weeds.*

Objective

Develop a county weed control program that provides:

- Responsible weed control
- Wise use of taxpayer dollars
- Groundwater and surface water protection

An *integrated* approach to roadside vegetation management means relying on a variety of weed control methods: mechanical, biological, chemical and cultural. IRVM emphasizes cultural control – establishing and promoting healthy, native vegetation – and tries not to rely exclusively on herbicides for controlling weeds.

Establish native vegetation
Native vegetation is the cornerstone of IRVM. Plant the best-adapted vegetation and keep it healthy. Iowa native plants are naturally adapted to the state's climate and growing conditions. They handle tough roadside conditions. Their tall growth and deep roots help prevent weeds. Keep the natives healthy with the use of prescribed fire.

Do not overuse herbicides
Overuse of herbicides weakens all vegetation, making roadsides more susceptible to invasion by weeds. Overuse of herbicides also eliminates desirable and harmless broadleaf species that would otherwise reduce weed invasion by occupying the same niche sought by weeds. For these reasons IRVM promotes careful *spot-treatment* of weeds when using herbicides.

Consider mowing
Mowing must be considered before resorting to herbicides. The effectiveness of mowing depends on targeted species and timing. The feasibility of mowing depends on roadside slope and available equipment. County road right-of-way is often not suited to tractors. Still, spot-mowing for weed control is encouraged and counties should look for ways to make this a more frequent and viable weed control option.

Canada thistle, a perennial, spreads aggressively by seeds and rhizomes. Maintaining a healthy native plant community helps prevent its establishment.

Pay attention to timing
Timing is key to successful vegetation management; the effectiveness of mowing and spraying depends on it. IRVM recommends hiring a full-time roadside manager as the best way to provide professional, proactive and systematic weed control.

Keep goals realistic
IRVM recognizes there is no such thing as total weed eradication, so have realistic goals. Accept the presence of some weeds and keep them at a manageable level. Weed species that pose no real threat to agriculture or natural areas should be tolerated. Prioritize weed control efforts, beginning with highly traveled roads.

Weed Life Cycles and Control Strategies

Annual weeds have a one-year life cycle. They germinate, grow, flower, set seed and die in one year or less. They reproduce by seed only. Common roadside annuals include common ragweed and giant ragweed.

To control:
- Mow prior to seed-set.
- Eliminate bare soil and disturbances to vegetation.

Biennial weeds have a two-year life cycle. In the first year a basal rosette (circular cluster of leaves on or near the ground) is produced. The second year a central, flowering stalk elongates and the plant dies after seed maturation. Biennials spread only by seed. Common roadside biennials include musk thistle, bull thistle, poison hemlock, wild parsnip and wild carrot.

To control:
- Mow prior to seed-set five consecutive years.
- Treat rosette plants with herbicides in fall or early spring when results are typically the best and damage to desirable plants can be minimized. (Biennials become much more tolerant of herbicides after the stem has elongated.)
- Establish native vegetation to deprive biennials of sunlight during their weak seedling stage.

Perennial weeds can live for a few years or for many years. Some perennials reproduce only by seed; many spread by seed and a variety of underground reproductive structures. Control of these perennials may be very difficult because of their extensive root systems.

To control:
- Treat with herbicides. *(continued, next page)*

When the population of an invasive species is small enough and the threat it poses large enough, some counties make the effort to "micro-manage." In this case, teasel plants not killed after herbicide treatment are cut and brought back to the shop. Seedheads are removed and bagged, then set outside in the sun to collect moisture and rot. These efforts have kept teasel – a troublesome biennial – from spreading in the county.

- Mow to prevent seed maturation and extend herbicide treatment window.
- Establish a diverse, native plant community.

Iowa's Herbaceous Roadside Vegetation Threats

Iowa's noxious weed list is outdated. It includes several species that no longer pose a threat to agriculture, and it does not include certain plant species now considered troublesome in the state.

The state's primary herbaceous (non-woody) roadside threats are listed in *Table 2* (page 47). Herbicides remain the most practical means of controlling these weeds in county road right-of-way.

Herbicide labels

Labels explain how to use the product effectively while protecting yourself, non-target plants and the environment. Take time to read the labels; it may be the most valuable time spent in weed control.

Adjuvants

Adjuvants are often added to the herbicide solution to increase its effectiveness. These products are put in the water tank at labeled rates.

- **Surfactants** improve dispersion and reduce surface tension of spray droplets resulting in increased penetration.
- **Crop oils and crop oil concentrates** also improve dispersion and, by being oil, keep leaf surfaces moist longer than water allowing more time for penetration.
- **Stickers** help prevent the solution from being washed off leaves.
- **Drift inhibitors** control drift.
- **Antifoaming agents** reduce foaming in the tank so it can be filled more easily.

Iowa's Roadside Trees and Brush

Iowa's noxious weed list includes a few woody species, and several non-listed trees and shrubs have become troublesome in non-agricultural land throughout the state. In roadsides, all trees and brush are potential safety hazards. The primary goal of county roadside tree and brush control is to provide safe roads for the traveling public. Safety goals include:

- Provide motorists unobstructed lines of sight.
- Ensure visibility of traffic control and warning signs.
- Eliminate immovable objects.
- Alleviate substantial and chronic drifting of snow.
- Reduce shade where it prolongs ice on the road.

Most roadside tree and brush control is accomplished by mechanical or chemical means. A correctly timed prescribed burn can also control brush.

Refer to Tree and Brush Control for County Road Right-of-Way, a 2002 Iowa Highway Research Board/UNI-IRVM publication, for complete brush control information. Herbicide recommendations from that publication – with updates – are shown in Appendix 5a.

Table 2: IOWA'S PRIMARY ROADSIDE THREATS AND HERBICIDE RECOMMENDATIONS

Species	Roadside Manager recommendations (2011)	Application schedule and notes *Refer to product label for recommended rates.*
Canada Thistle *perennial*	• Milestone • Transline (early season) • Telar (late season) • Transline/Telar (mid-season) • Perspective	Most effective control: Bud to bloom, or late fall just before frost; mowing increases efficacy of fall treatments. Growth stage is key, so treatment time can be flexible: • We've had success killing thistles with Milestone in early-August if they were mowed in June/July and have adequate regrowth. • We've also had good luck with Milestone after hard frosts, as late as the last week in October. As long as it's green in the fall, spray it! Volatility may be an issue with Perspective in the summer.
Musk Thistle *biennial*	• Milestone • Garlon • Opensight • Streamline • Escort XP • Overdrive • Transline • 2,4-D	Most effective control: Rosette stage during spring or fall. Herbicides with good residual activity (e.g., Milestone, Opensight) appear to be the most effective over the long-term. Adding 2,4-D helps with burndown. Tank mixing 2,4-D with Overdrive = very rapid burndown.
Bull Thistle *biennial*	• Milestone • Garlon • Opensight • Perspective • Escort XP • 2,4-D • Transline	Same as musk thistle.
Teasel *biennial*	• Milestone • Roundup • Escort XP • Transline • Garlon • 2,4-D	Most effective control: Rosette stage during spring or fall. For small populations, cut off seedheads, destroy and dispose properly. Use a stout dose of herbicide and ***monitor***. Teasel is tough; flowerheads and seed can be produced after treatment.
Poison Hemlock *biennial*	• Opensight • Roundup • Telar • 2,4-D	Most effective control: Rosette through pre-bloom, early spring.
Leafy Spurge *perennial*	• Plateau • Perspective • Banvel • Roundup/2,4-D • Vanquish	Most effective control: Spring or fall. Plateau works well and is most effective in the fall, just before frost. Pull or respray plants that appear after treatment. Use biocontrol for large infestations: flea beetles *(Aphthona spp.).*
Purple Loosestrife *perennial*	• Garlon 3A • Aquatic Roundup • Habitat	Most effective control: June to August.
Wild Parsnip *biennial*	• Escort • 2,4-D • Opensight	Most effective control: Rosette stage.
Japanese Knotweed *perennial*	• Habitat • Arsenal Powerline • Polaris • Roundup	Most effective control: Summer. Use a good surfactant, e.g., MSO with Arsenal, and Liberate with Habitat.
Sericea Lespedeza *perennial*	• Garlon • Escort XP	Can use either herbicide all summer. For best results use Garlon prior to branching (~July 4), and Escort in Aug. & Sept.
Russian Knapweed *perennial*	• Milestone • Perspective	Most effective control: Spring.
Garlic Mustard *biennial*	• Roundup	Spray rosettes in early spring (late Feb - early April) or late fall when little else is green to avoid non-target plants. Escort XP and Streamline may be effective, but due to residual activity should not be used where non-target species could be affected.

Notes: The mostly commonly used brand names are shown here. Many of these products are now available under other (often less-expensive) labels.
Where Garlon (triclopyr) is noted, either Garlon 3A (amine formulation) or Garlon 4 (ester) can be used. Garlon 4 is usually more effective but in hot weather can volatilize, drift and affect non-target species. 3A is non-volatile and usually considered the best choice for hot weather.

Ways to Reduce Herbicide Use

- Know which weeds (under what circumstances) actually constitute threats.
- Know each herbicide's target species and appropriate application schedule.
- Know the latest, most accurate herbicide application technology.
- Work with adjacent landowners to eliminate disturbances that cause weeds.
- Hire conservation-minded operators for county spray crews.
- Resist outside pressure to do more spraying.

Landowner Education

Resisting outside pressure to apply more chemicals might require educating a landowner – or even a member of the board of supervisors – why it may be inappropriate to spray. The following points can be helpful when talking to someone whose weed control philosophy is based primarily on experience with row crops and lawns.

Nothing beats face-to-face communication. A strong, sincere approach can reduce the number of calls and complaints received by the county.

- Roadside weed control bears no resemblance to row-crop weed control. Corn and soybeans are annual species maintained in bare soil, a practice that invites weeds and requires continual cultivation and herbicide use. Native seed mixes designed for roadsides create diverse stands of perennial vegetation that prevent weeds by occupying all available space. Overuse of herbicides works against this method of weed control.
- Native prairie grasses and wildflowers may be tall and can appear unkempt, but these are the plant species most adapted to Iowa's climate and growing conditions. Their extremely deep roots enable them to survive environmental stresses and their unique metabolism allows them to grow tall and thrive during long, hot summers. Because of these characteristics, native plants out-compete weeds.
- Broadleaf species (wildflowers) included in native seed mixes are part of the plan. They occupy a niche in the plant community otherwise used by weeds. They are not a threat to agriculture.
- A pure stand of any grass is an unnatural condition sustainable only through the use of herbicide.
- Overuse of herbicides in any roadside creates openings for weeds by weakening grasses and eliminating beneficial broadleaf species.

County Weed Control

Most counties that provide their own weed control:

- Dedicate one full-time employee for much of the summer
- Hire two seasonal employees
- Purchase and maintain one primary spray rig
- Spend between $8000 and $24,000 on chemicals each year
- Cover at least half the county each year
- Maintain herbicide applicator licenses and certifications
- Provide proper herbicide storage
- Properly dispose of herbicide containers
- Keep up with the latest developments in herbicide and sprayer technology

Benefits of providing in-house county weed control:

- The county has more control over how roadsides are managed. Sensitive areas such as gardens, bee hives, organic farms, prairie remnants and roadside wildflowers are protected.
- Having someone on staff who knows how to apply herbicides and effectively control weeds is a great asset for roadside management and management of county recreation areas as well.
- When the person overseeing the program lives in the county, personal pride and accountability become part of the equation resulting in a more conscientious effort.

IRVM Herbicide Application History

In the early days of IRVM, many counties sent crews into the ditch equipped with backpack sprayers. They carefully spot-sprayed weeds. While this method provided good weed control with a minimal amount of herbicide, roadside managers soon learned they could not cover enough of the county.

Since then IRVM has helped drive the development of spray truck technology that delivers herbicides with the accuracy and control needed to live up to the program's original principles – killing target species without weakening non-target species or putting too much chemical on the ground.

Progress has been made, not just with more responsive on/off control switches and multi-directional spray nozzles, but with systems that monitor flow, record data and greatly reduce operator exposure. As with any spray equipment, these systems are only as good as the person whose finger is on the trigger. The objective is still to spot-spray. Beware of getting comfortable and sitting too long in the cab. Be conscientious, stay alert and be ready to grab the handheld sprayer and walk to that distant shrub to treat it properly. Never underestimate the value of your own labor; sometimes it's still best to put on the old backpack.

This truck is equipped with an exterior seat for more accurate spraying.

Spray Systems

Counties typically use truck- or trailer-mounted chemical injection (high-end) or tank mix (basic) spray systems. The following is one county's description of its two spray rigs. These fairly well represent the range of equipment available.

Our high-end unit is a Legacy 6000 chemical injection system from Mid Tech. This unit has a GPS to record the rate, type and amount of chemical used. We download that info to our desktop and print out reports. Our system has three injection pumps with three chemical tanks, and a 300-gallon water tank all on a skid for easy loading and unloading on the pickup. All the controls and the electric start are mounted in the cab on a computer stand. We have three bumper-mounted spray nozzles – 6 ft., 20 ft. and 30 ft. – and a hose reel with 300 ft. of hose in the back. We like this unit because we can easily switch chemicals to spray something else and one person can load and unload everything in less than an hour. A downside of this system: we can only use liquid chemicals, otherwise everything gets plugged up.

Our basic unit can also be loaded in the truck by one person. Just about any chemical can be used because it's a tank mix system with an agitator in the tank. It has a 200-gallon tank, also on a skid, run by a 5½ HP motor. We have two nozzles, a 6 ft. and a 30 ft., on the right-front bumper. There is a hose reel in the back with 200 ft. of hose. There's no GPS on this system, so we have to keep track of everything. We mounted switches in the cab to run the nozzles, but we have to get out to turn the system on and off.

Top left and top row: Console and two chemical injection rigs. Bottom row: Tank mix rigs.

Another type of truck-mounted spray system used in roadsides is an invert emulsion sprayer. Invert emulsion was developed to reduce herbicide drift and volatilization by producing large droplets of water surrounded by oil. The mayonnaise-textured droplets do not dry as fast as water, so leaf penetration is improved. Invert emulsion sprayers do not work with all types of chemical products; liquid formulations usually work best.

Spray Nozzles

Bumper-mounted nozzles or raised, multi-section, nutating spray nozzles are typically used on county rigs. The following is one county's description of both nozzle types:

A multi-section, nutating spray head allows a mindful operator to choose which section of the ditch to spray – in 2, 4 or 6 foot increments out to 30 feet. A system with multiple bumper-mounted nozzles can spray different distances too, but they tend to spray everything up to that distance. The multi-section system uses less herbicide primarily by hitting a narrower band. But if operators of multi-section systems hit all seven switches every time they spray a single thistle – just to make sure they don't miss – there won't be much reduction in herbicide. Ultimately a good operator still makes the difference.

Nutating spray head (left) and spray pattern with all nozzles on (right). Nutating spray heads use banks of solid-stream nozzles that move rapidly in a vertical plane and produce larger droplets, potentially reducing off-target drift.

Traditional bumper-mounted nozzles (right) and spray pattern (left). Bumper-mounted nozzles produce smaller droplets and a wider spray pattern.

Spray System Components with Options

- Skid-mounted or permanent truck or trailer installation
- Water tank: typically 300 – 750-gal; 1,000-gal requires CDL
- Chemical mixing systems: tank-mix system with mechanical agitation (chemicals added manually to the large water tank) or chemical injection system with 2 to 3 separate chemical tanks (chemicals mixed with water after passing from tank)
- Water pump: roller, piston, centrifugal and diaphragm pumps are used
- Water pump motor: 5.5 – 11 HP; Honda is popular
- Injection pumps: at least 20 to 40 GPM; electric start optional
- Hose reel: 200 to 300 ft.; ½ in. to ¾ in.; electric rewind recommended
- Spray gun or spray wand attached to hose
- Truck-mounted spray heads, one side: generally either 2 to 4 bumper-mounted nozzles or a raised, nutating head with multi-direction spray sections
- Console: holds controllers, switches, GPS, computer
- Controller: sets application rate
- Flow meter: records herbicide application data
- GPS: maps spray location
- Software

Backpack Sprayers

The backpack sprayer is the best way to reduce herbicide use and target specific invasive plants, especially in diverse wildflower plantings.

- Use a low-volume backpack sprayer. Birchmeier™ and Solo™ are good brands.
- A 4-ft. wand reaches right down to the target plant.
- Herbicides made to kill broadleaf weeds will also kill wildflowers.
- Transline works on tough weeds without a lot of residual effect.
- Follow the rates on the label for mixing the spray.

Pesticide Applicator Certification

Anyone who applies pesticides for a county agency or other government entity must be certified. The Iowa Department of Agriculture and Land Stewardship – Pesticide Bureau administers the state's pesticide applicator certification process. A description of this process – and related information – is in Appendix 5b.

Internet Resources

Excellent, up-to-date information about invasive species and their control is available on the web. Take advantage of the following websites.

Weed and invasive species information

www.dcnr.state.pa.us/forestry/plants/invasiveplants/index.htm
From the Pennsylvania Department of Conservation and Natural Resources, many of the species covered are also troublesome in Iowa. *Fact Sheets* discuss identification, distribution and biology; *Management and Control* information covers mechanical, chemical and bio-control compiled from a variety of invasive species websites.

http://mdc.mo.gov/landwater-care/plant-management/invasive-plant-management
From the Missouri Department of Conservation – Plant Management, note especially the links to Invasive Plant Management and Nuisance Plant Management. These pages outline ID and control of many invasive and troublesome Iowa species.

www.invasive.org/eastern
Many of Iowa's invasive/nuisance plants are included in this list of invasive species of the Eastern United States. Pictures and control methods are provided.

fyi.uwex.edu/weedsci
Invasive plant management information from the University of Wisconsin Weed Science Cooperative Extension.

Herbicide information

http://onlinemanuals.txdot.gov/txdotmanuals/veg/quick_rate_chart_for_percentage_solutions.pdf
Use this chart to determine percentage rate of herbicide per gallon of water.

http://learningstore.uwex.edu/Herbicide-Effectiveness-on-Invasive-Plants-in-Wisconsin—P1376.aspx
A downloadable UW-Extension chart highlighting the effectiveness of 32 herbicides on 32 different invasive plants in Wisconsin.

http://www.cdms.net/LabelsMsds/LMDefault.aspx
Use this ag chemical database to find MSDS sheets and product labels. Search by manufacturer or product name.

www.epa.gov/pesticides/chemicalsearch
The EPA's Office of Pesticide Programs has created this Chemical Search with access to a broad array of published scientific and regulatory information on active ingredients used in registered pesticides.

Herbicide Resources

Herbicide Suppliers

Midwest Spray Team & Sales, Inc., Lyle Christensen, 515-238-1616

Van Diest Supply, Chris Roberts, 515-314-3898

Herbicide Manufacturers & Reps

Dow AgroSciences, Jamie Baumgardner, 712-299-2583, jdbaumgardner@dow.com

DuPont Land Management, Scott Ohnoutka, 605-731-9772, scott.ohnoutka@bayer.com

Crop Production Services (UAP), Bill Walker, 605-645-1636, william.walker@cpsagu.com

Herbicide Spray Equipment Companies

C & R Supply, Kevin Crisp, 800-322-2637

Dultmeier Sales, Mike Sall, 800-228-9666 x5537

Minnesota Wanner, Tom Wanner, 612-929-1070

Comments

General Weed Control

I publicize in the paper when we will start spraying, and encourage people to call me with locations of sensitive areas – gardens, bee hives, allergies, etc. I have "No Spray Zone" signs for willing landowners. ***Jeff Chase, Des Moines County, 2009***

Higher diversity roadsides are more robust, more resistant to weeds. Maintain high diversity even if you don't have the opportunity to establish natives. Don't spray species that are not problems, even if they're considered weedy. ***Wes Gibbs, Jones County, 2009***

One half of our county is sprayed each year for noxious weeds, by contractor. 99% of the spraying is for thistles because that's the only species I receive complaints about. Nobody cares about sour dock, etc. All brush spraying is done by the roadside manager. We try to get half the county opposite the contractor sprayed for brush. Maintainer operators report high priority areas for brush spraying and I try to address those first. ***Wes Gibbs, Jones County, 2009***

I mostly use the web or my sales rep for technical support. It's too hard to maintain up-to-date, written information on the most effective herbicides for each species. But like anything else, the advice is only as good as the source. ***Josh Brandt, Cerro Gordo County, 2009***

My weed control procedure is to first check Muenscher's book, Weeds. Suggested control is usually of a manual or mechanical nature, i.e. mowing, hand hoeing, cutting roots below the surface, etc. In certain situations this can be helpful, but more importantly it gives me a feel for the plant I'm trying to control. ***Linn Reece, Hardin County, 2010***

We don't spray shoulders, just bridge abutments and guardrails. ***Jim Uthe, Dallas County, 2010***

We plan on spraying garlic mustard since we just have it in isolated patches along timber and small creeks. We don't spray wild parsnip unless asked or if there's a really rank patch. Unfortunately, if we tried to spray every parsnip plant we'd essentially be blanket spraying many areas.
Jim Uthe, Dallas County, 2010

We have isolated patches of garlic mustard that get sprayed. However, what exists in the ditch is usually spill over from the woods. What makes it to the ROW is just the tip of the iceberg, so I don't get too excited about chasing it down. We have plenty of parsnip that, historically, was sprayed every year. Still have plenty of it. We do not spray parsnip anymore. ***Wes Gibbs, Jones County, 2010***

Patches of most biennials (e.g., musk thistle) can be controlled in 2-3 years with diligence.
Linn Reece, Hardin County, 2011

I know we use much less herbicide when we treat cut stumps as compared to when we foliar spray trees – with much less collateral damage to adjacent plants. And taxpayers are saved the cost of cutting or mowing the same tree over and over. ***Rob Roman, Linn County, 2011***

Spray Systems

We have an 800 gal tank. I like using a lot of water; bigger droplets = less drift.
Jim Uthe, Dallas County, 2011

Bigger tanks mean less time mixing and loading. ***Bryce Schaben, Shelby County, 2011***

Our spray rig came with an 8HP engine which failed due to a mechanic's error and was replaced with an 11HP due to availability; the 11HP has worked great pumping 136GPM & 180 PSI, minimum. More water = bigger drops = less drift. ***Jim Uthe, Dallas County, 2011***

If using a high pressure pump, get two separate discharge ports to lock out the hose reel when not in use. Hose can come unwound. Hannay hose reels and Hypro spray wands work well.
Andy Friederichsen, Clinton County, 2011

The Legacy 6000 can be used as a datalogger and rate controller. When our old datalogger died, we just piggybacked the Legacy onto our existing rate controller because it was a lot less work than redoing everything. ***Jim Uthe, Dallas County, 2011***

We recommend a minimum of 2 chemical injection tanks, 1 brush, 1 thistle. A third tank is nice to hold 2,4-D for use on large patches of various undesirable weeds (giant ragweed, hemp, crown vetch, parsnip, hemlock, etc.). ***Jim Uthe, Dallas County, 2011***

We're simplifying things by using a "multi-use" chemical on the trucks, so we suggest only two injection tanks ... or just one. The reason we've gone to one chemical for controlling brush and thistles is more due to operator and controller issues, than chemical issues. A good, versatile chemical means less operator error and eliminates "lag" in the controller.
Andy Friederichsen, Clinton County, 2011

We recommend a centrifugal pump if using spray nozzles and a diaphragm pump if using a spray wand. ***Andy Friederichsen, Clinton County, 2011***

We have a C&R Supply Roadside Actuator with three Boombuster nozzles. We use only two of them. The system uses a lot of water (which is why we like a bigger tank), but it was relatively inexpensive and provides very good coverage. ***Andy Friederichsen, Clinton County, 2011***

We use eight boom widths with additional fan nozzle for tall brush. ***Jim Uthe, Dallas County, 2011***

The multi-section heads are great, however if spraying large brush, 6-8 ft. tall, striping is a big concern. The head does not produce a spray pattern to provide good coverage.
Andy Friederichsen, Clinton County, 2011

You need to get good ball valves to turn on and off every spray section in the spray head. Solenoid valves, like the TeeJet 144a, do not last; there's constant replacement of diaphragms. We condensed the 9-section head to a 5-section head. It still has the same amount of nozzles, just using fewer valves by tying the nozzles together. ***Andy Friederichsen, Clinton County, 2011***

A flatbed sprayer with a crew member standing on the back of the truck spraying thistles and brush with a hand wand seems to be more accurate than a top-of-the-line spray head and the initial costs are way less expensive. But OSHA may not be allowing a crew member to stand on the back of the truck much longer. ***Andy Friederichsen, Clinton County, 2011***

With our rig, we can't go the 10 mph the literature states; we go in the 3-5 mph range.
Andy Friederichsen, Clinton County, 2011

6 PRESCRIBED BURNING

Prescribed fire is an essential component of native vegetation establishment and management. Though challenges are associated with the process, prescribed burning can be executed safely and effectively in the roadside environment.

Prescribed fire is a management tool used for two main objectives:

- Discourage the growth of invasive and woody plants.
- Invigorate the growth of native plants.

A timely burn can slow the growth and spread of weeds and small trees, both of which are susceptible to the intense heat associated with fire. Most native prairie species, on the other hand, have a positive response to fire. Historically, this ecological relationship was critical to the existence of the tallgrass prairie, and today it continues to be an essential management practice in roadside prairie remnants and plantings.

Preparing for a Burn Season

Properly trained staff, the right equipment and advance planning are key to a successful and safe prescribed burn.

Training and Personnel Requirements

Though there are no state-wide minimum requirements for individuals participating in roadside burns, training opportunities are administered by the Iowa DNR that provide basic information for performing safe prescribed burns.

The minimum recommended training session is S130/190, which covers the basics of fire behavior and wildfire fighting techniques. This 40-hour course, combined with an annual eight-hour refresher, is adequate preparation to participate in a prescribed roadside burn. A combination of experience and additional training may be necessary to plan and lead a successful and safe burn.

Staff requirements for roadside burns vary with the conditions at each site; the size of the crew depends on the size and complexity of the burn. As a general rule, two to four qualified people can safely execute most roadside burns. Burning alone or understaffed is not advised, so it may be necessary to coordinate efforts with other agencies. Secondary road maintenance crews, county conservation boards, local fire departments, and other county IRVM programs are possible partners.

Personal Protective Equipment (PPE) standards vary among agencies, but some general guidelines should be considered.

This fire crew is wearing Nomex and other highly recommended personal protective equipment.

Minimum Suggested PPE

- Leather work boots
- Gloves
- Safety glasses
- Clothing made of natural fibers

Highly Recommended PPE

- Helmets
- Face and neck shrouds
- Fire retardant clothing such as Nomex
- Goggles

Equipment*

All ignition and fire-fighting equipment should be inventoried, inspected and tested prior to the burn season and immediately before each burn. The following are the basic tools used when burning roadsides.

Ignition Tools

Drip torches are the most efficient tool for igniting prescribed burns.

- Two drip torches containing a 2:1:1 diesel/kerosene/gasoline mix or, if kerosene can't be found, a 2:1 diesel/gasoline mix
- Pre-mixed fuel in safety cans
- Lighters

Drip torches are filled with pre-mixed fuel a safe distance from the fire line.

Hand Tools

Hand tools are used to remove combustible materials and smother fire. They are often used to create fire lines and mop up after the burn.

- Rubber flappers
- Fire rakes
- Fire brooms
- Shovels
- Gas-powered blowers

Water Supply

Numerous styles of water tanks and pumping systems are effective for use in roadside burns. Some systems are designed specifically for fire suppression; others can also be used for management practices such as herbicide application. Additional features such as fire resistant hosing, electric hose reels and adjustable pattern spray guns improve the effectiveness of the rig.

Tractors and ATVs can also be equipped with tanks and water pumping systems. These rigs can quickly access locations that may be inaccessible to larger equipment. They have smaller tank

capacities, but can move personnel and equipment more efficiently along the fire line.

- 3/4 to 1-ton truck equipped with a 300-400 gal. tank and pump
- Tractor and/or ATV equipped with 50-100 gal. tank and pump
- Backpack pump sprayers
- Additional storage tank or trash pump to refill equipment

Top: A 400-gallon spray rig equipped with a centrifugal pump and a 300-foot hose. Bottom: Back-up water can be drawn from nearby water sources with a trash pump.

Communication Devices

Communication with the burn crew during a prescribed fire is critical. It is also important to maintain a communication link with agency headquarters and local authorities prior to, during and after a burn.

- Two-way radios
- Cellular phones

Weather Data Collection Devices

Weather data must be collected to ensure conditions are within the parameters of the burn plan. Hand-held weather units are inexpensive, accurate and the most effective means of monitoring on-site weather conditions. Hourly printouts are available from NOAA for specific areas.

Signage and Traffic Control Devices

The use of warning signs and other traffic control devices is highly recommended. The extent of the warning measures depends on the traffic flow and difficulty of the burn.

- Warning signs "Prescribed Burn Ahead" or similar
- Vehicles with flashing lights
- Flaggers

*Much of the equipment needed for prescribed burning can be purchased from vendors such as those listed below. See LRTF Funding Guidelines for information about prescribed burn equipment and PPE grants and ordering procedures.

- Forestry Suppliers, Inc.
- Ben Meadows Company
- Gempler's

Hand-held weather unit.

Public Notification

Prior to a burn season, notify the public that trained personnel will be conducting prescribed burns in the ROW with specific management objectives in mind. A simple press release (*Appendix 6a*) to the local media will do. Adjacent landowners can be notified in person or by letter as part of the planning process (*Appendix 6b*). Any questions/concerns should be addressed at this time.

Developing a Plan For the Season

Goals and objectives for the upcoming burn season should be established in advance. This includes developing a list of potential burn sites and prioritizing that list. A simple spread sheet (*Appendix 6c*) is a good way to compile and organize this data.

There is often only a small window of time during which conditions are appropriate for prescribed burning. For this reason, it is critical to establish clear objectives, so sites of highest priority can be burned first. A reasonable goal for burning native prairie remnants or plantings is approximately *once every 3-5 years*, and should be prioritized on the list accordingly. Some sites may require more frequent burns to address weed or brush infestations. Those should be moved higher on the list.

As a general rule, any burn is better than no burn. While it is common to burn whenever conditions are favorable, the seasonal timing of a burn will have an impact on the plant community's response:

Routine maintenance (thatch removal)	Any time
Weed control*	Late spring
Brush control*	Spring
Warm-season grass stimulation	Mid- to late spring
Cool-season grasses	Enhanced by early spring and fall burns Suppressed by late spring burns
Forbs	Enhanced by early spring and fall burns
** Research specific weed and brush species before using fire for management. Some may have a positive response to fire.*	

Burning after spring green-up produces extra smoke, requiring additional safety precautions and planning. Lower fuel moisture levels during early spring and fall produce less smoke. Burning around signs, and other hazards, removes the fuel load before the primary fire line arrives.

Developing a Burn Plan

A complete burn plan, developed in advance, is the first step toward executing a successful burn. The following information should be included:

- Area to be burned
- Potential hazards
- Desired weather parameters
- Equipment and personnel requirements
- Firebreaks and anchor points
- Special concerns

A sample burn plan and sample weather data are shown in Appendices 6d and 6e.

Area to be Burned

Identify the areas within a potential burn site that will benefit most from prescribed fire. A complete burn of an area is not always desired; the practice of patch burning is beneficial to many insects, birds and small mammals. Patch burning will result in a mosaic of burned and unburned areas.

If the fuel load is high enough, prescribed fire can be used to set back or kill woody vegetation. In this photo, woody stem density has reduced the combustible fuel load, making it difficult to sustain a fire intense enough to significantly damage the brush.

Potential Hazards

Potential hazards are anything that should not burn during the prescribed fire. This includes adjacent vegetation, utility poles and boxes, fences, signs, plastic culverts and tile intakes. Identify these items in advance and mitigate the danger by reducing the fuel load around the hazard and/or thoroughly watering the area prior to ignition.

Fuel loads around hazards can be reduced prior to the burn season by weed-whipping surrounding vegetation.

During the burn, a backpack pump sprayer can be used to create a wet line around wood utility poles.

Adjacent vegetation	Burn/no burn
Crop residue (worked)	Burn with low/moderate winds
Crop residue (not worked)	Burn with high humidity and light winds
Standing crop	NO burn
CRP/Pasture/Timber	Burn with prepared firebreaks and light winds

Adjacent vegetation patterns affect how and when a burn should be performed.

Weather Parameters

Weather is the most important outside factor affecting fire behavior, so it is essential to determine the weather parameters within which each burn can be safely executed. The following are reasonable guidelines for conducting most roadside burns.

- Temperature 40 - 70 F
- Relative humidity 30 - 70%
- Wind speed 5 - 15 mph
- Wind direction Away from the road and safety-sensitive areas

Equipment and Personnel Requirements

Identify one person as the burn boss and determine the number of people required to safely carry out the burn based on the size and complexity of the area in the prescription. Consider that additional support staff may be required in highly traveled areas to assist with traffic control and address questions from the public.

Prepare a site specific list of ignition, fire-fighting and safety equipment needed for the burn.

Firebreaks and Anchor Points

Firebreaks and anchor points are critical to starting and stopping a prescribed fire and their respective locations should be identified as part of the burn plan. Roads, field drives, agricultural fields, mow lines and wet lines may all be used as firebreaks.

The anchor point of a prescribed fire is the position at which the burn is first ignited. This location is typically the most downwind position and must be completely secured before continuing with the burn.

Special Concerns

Many other outside factors such as traffic patterns, visibility issues, residential areas, livestock operations and high-voltage power lines may require consideration. Identify as many of these special concerns as possible in advance to mitigate the dangers associated with them.

Mowed field access drives create excellent fire breaks and can be used to both anchor and stop a burn.

Mowed fire breaks, wet lines and hand tools are used to establish an anchor point. The fire should not progress until a sufficient black line is present.

To prevent a line-to-ground electrical discharge, do not allow smoke to build up under power lines.

CONDUCTING A PRESCRIBED BURN

Pre-Burn Activities

Review the burn plan. Does the burn fit the prescription?

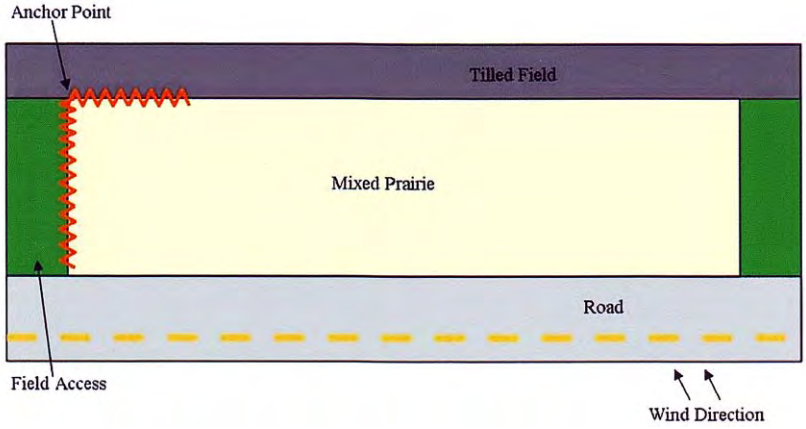
Pre-Burn Checklist

- Check weather forecast
- Observe adjacent land use activities and make notifications
- Collect on-site weather data
- Check equipment
- Install signage and traffic control measures
- Develop a plan of attack and brief personnel
- Assign duties
- Notify headquarters and local authorities

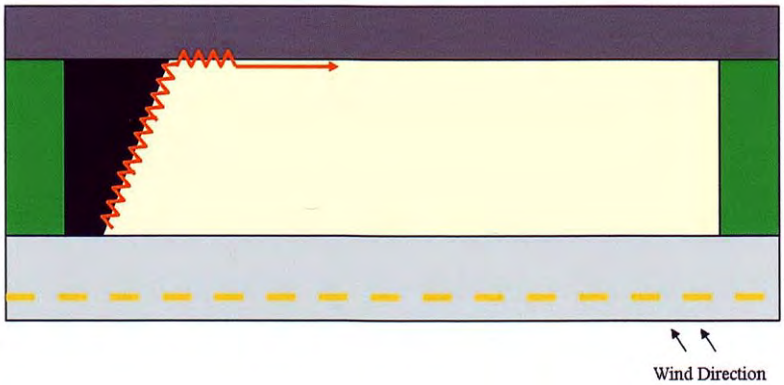
The Burn

Ignition

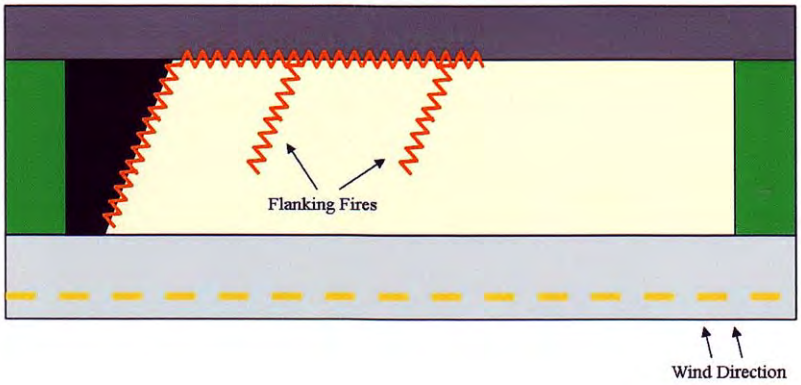
Wind direction and location of firebreaks will determine the point of ignition. Establish the anchor point at the most downwind position and secure that location before continuing down the fire line. Burning into the wind with a backing fire will maintain a slower, controlled burn.



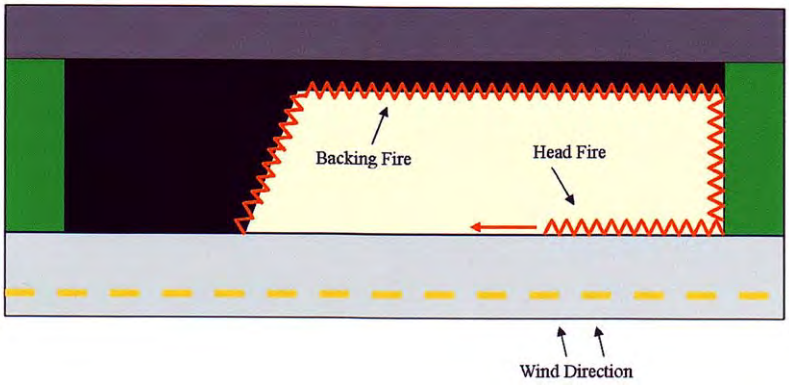
Continue ignition along the fire line pausing as needed to allow for suppression near potential hazards such as utility poles, fence posts and tile intakes.



If the fire is progressing slowly due to conditions such as low fuel loads, undesirable wind patterns or high humidity, use a flanking fire to increase fire intensity.



Slow backing fires result in the least amount of smoke and the most complete combustion, but igniting a head fire may, at times, be desirable to speed up a burn. After adequate black lines have been established along all downwind positions, a head fire can be ignited with caution.



After the Burn

Post-Burn Checklist

- No flames - no smoke
- All smoldering materials extinguished
- Firebreaks secured
- Personnel debriefed
- Weather data collected
- Headquarters and local authorities notified

Record Keeping

Complete records are necessary to support a prescribed burning program. Recording and compiling data for each burn will help establish future management objectives.

Smoldering logs and other debris are mopped up with water or hand tools after the burn is complete.

Comments

Preparing for a Burn Season

I recommend the use of official county letterhead / memo format when notifying adjacent landowners. It looks professional and more like normal county business, rather than just a note from a county employee. I like using the wide open time frame ("this spring") in my memos and mailing them about a month prior to the burn. If notification has to be on short notice, use different wording and hand deliver, hanging the memo on a door handle if necessary. This shows you're making an effort to let landowners know what's going on. ***Wes Gibbs, Jones County, 2011***

While it's important to inform the public and media about prescribed burns, you don't want to attract unnecessary distractions to site. It's critical that all personnel have their full attention on the burn. The presence of additional people, such as the media or the general public, can distract the burn crew, and increase traffic congestion. ***Josh Brandt, Cerro Gordo County, 2010***

Plan for the worst with water and equipment so you're not under-prepared. Roadside burns can be challenging, but when done correctly, they're not a big deal. It's an accepted management practice that's cheaper than spraying and cutting. ***Wes Gibbs, Jones County, 2010***

We try to vary burn seasons and intervals between burns so we aren't adversely affecting any one set of desirable species. ***Jim Uthe/James Devig, Dallas County, 2010***

We currently use 2:1 diesel/gasoline because kerosene it hard to get. 2:1 is temperature sensitive, sometimes hard to ignite when cool and very volatile when hot (shooting jets of flame). When we use kerosene, we use 2:1:1 diesel/kerosene/gasoline because just diesel and kerosene can be hard to ignite. It can also get volatile when temps are above 80º (probably shouldn't be burning anyway).
Daryl Smith, Tallgrass Prairie Center, 2011

Conducting a Prescribed Burn

Stick with your burn plan. Even if you've spent a lot of time getting equipment and personnel to a burn site, if on that day conditions in the field do not meet your burn plan, DO NOT BURN.
Linn Reece, Hardin County, 2011

Before checking my potential burn site list on the day of the burn I check two if not three of the following websites:
www.weather.gov (NOAA)
www.weather.com
http://www.netexpress.net/~okeefe/
These all give hourly info about upcoming weather to help us decide if, where and when to burn. This alerts us to possible weather changes signaled by a change in wind direction and speed and other factors. ***Linn Reece, Hardin County, 2011***

A small test burn at the anchor point will indicate fire and smoke behavior and the feasibility of continuing with the prescribed burn. ***Jon Steege, Fayette County, 2011***

Put the slowest man on the drip torch. ***Linn Reece, Hardin County, 2010***

We use strip head fires to speed up the burn without using a full-blown head fire. It works well with a smaller crew. ***Jon Steege, Fayette County, 2011***

We use a Scotty Foam Fire Pump and Backpack (self-contained) and also a Scotty Garden Hose Foam kit. The optional grass line outlet on our fire unit provides the water pressure. Good for stubborn smoldering ties and stumps. ***Linn Reece, Hardin County, 2011***

Multi-use tanks and pumping systems should be thoroughly cleaned inside and out before being used for a new purpose. ***Jon Steege, Fayette County, 2011***

APPENDIX

APPENDICES

COUNTY VEGETATION MANAGEMENT SURVEY

Use this survey as a tool for evaluating existing roadside management practices. The results will identify the program's strengths and weaknesses, and be a guide for shaping the direction of the program's future management practices. The survey is primarily intended to be used by an IRVM steering committee. Responses can be subjective, varying widely from one person to the next. Interviewing roadside management personnel will add validity to the process.

Rate each of the following by circling all responses that apply.

1. Tree and brush control

a. Maintenance of sight lines

Very good Adequate Inadequate Big need

b. Maintenance of recovery zone

Very good Adequate Inadequate Big need

c. Removal of trees that present immoveable objects

Very good Adequate Inadequate Big need

d. Removal of hazardous tree limbs

Very good Adequate Inadequate Big need

e. Amount of tree cutting in general

Well-balanced approach Too aggressive Negligent

f. Quality of tree and brush cutting

Clean & professional Not too bad Eyesore

2. Weed control

a. General perception of roadside weed control

Very good Adequate Inadequate Big issue Not an issue

b. Amount of roadside spraying being done

Well-balanced Excessive Inadequate

c. Effectiveness of roadside weed spraying

Good results Making progress No sign of improvement Losing ground

d. Characterize the application of herbicides

Responsible Inconsistent Indiscriminant

Weed control continued on page 2 ...

Weed control continued ...

e. Do spray crews need to cover more of the county each year?

Yes No Not the main concern

f. Is most weed spraying completed during May, June and September when spraying is most effective?

Yes No

g. When a landowner complains about roadside weeds, but the weeds in question are not considered much of a problem, do you ...

Take advantage of the opportunity to explain the county's IRVM program and weed control priorities

Automatically spray the weeds

3. Who does the roadside seeding?

Private contractor Private contractor does larger projects

Secondary Roads Conservation

4. When is native vegetation used in roadsides?

After nearly all road projects High profile projects

Ditch cleanouts Wide rights-of-way

Not at all

5. Equipment needs

Consider working condition, current technology, appropriateness and availability of each of the following and recommend what equipment needs to be replaced or added.

Trucks Tractors

Spray equipment Chainsaws

Mowers Seeding equipment

6. Number of employees with:

Weed control as primary responsibility during spray season

Brush control as secondary responsibility year-round

Herbicide applicator certification

Chainsaw and boom mower experience

Vegetation management knowledge/background

Native plant establishment/management experience

Prescribed burn experience/certification

7. **How much is the county currently spending on:**

   Tree and brush control

   Weed control

   Seeding road projects

   Erosion control measure installation

   Weed commissioner salary

8. **Based on the responses to these questions, which of the following are recommended?**

   Hire a full-time professional roadside manager

   Hire a 9-month assistant roadside manager

   Hire more seasonal help

   Hire better-qualified seasonal help

   Free up more existing personnel for roadside management

   All of the above

Position Description (MSWord)

_____ COUNTY, IOWA

POSITION DESCRIPTION

Position Title: Roadside Vegetation Manager
Department: County Engineer *or* County Conservation *or* Independent
Supervisor: County Engineer *or* Conservation Director *or* County Supervisors
Salary Range: $35,000 - $45,000

Definition
A permanent, full-time position for the general implementation of the county's Integrated Roadside Vegetation Management (IRVM) program and duties associated with all aspects of vegetation management within county secondary road right-of-way (ROW) corridors. Primary work activities are focused on the continued maintenance and development of safe travel corridors for vehicles and the application of sound ecological principles to manage desired vegetation types along those corridors.

Optional:
- Will perform related duties as required by the county engineer.
- Will work directly with parks and wildlife area managers to assist them with routine public land and facility management goals and objectives.

Duties and Responsibilities

1. Direct the assigned staff in the design and implementation of the county's IRVM plan.
2. Control noxious weeds in road rights-of-way, particularly those species identified by the county IRVM committee.
3. Coordinate and assist with control and removal of woody vegetation along county roadways.
4. Establish vegetation, primarily native, in cleaned, regraded and newly created ROW.
5. Conduct prescribed burns in selected county road ROW.
6. Conduct safety training for assigned staff.
7. Perform all duties and responsibilities of County Weed Commissioner.
8. Develop a program of public information and education to promote public understanding of IRVM and wise land use practices that support IRVM objectives.
9. Inventory and document plant communities and related conditions along county ROW.
10. Manage those areas of native vegetation identified by the inventory process to improve diversity and overall health.
11. Maintain accurate, up-to-date records of the following activities: herbicide application, seeding and reseeding, prescribed burning, tree and brush removal and timely handling of complaints from county residents and other government agencies.
12. Assist with and perform scheduled and non-scheduled routine equipment maintenance and arrange with supervisor for non-routine work to be completed by private vendors.
13. Direct and assist with production, harvest and processing of native seed for use in ROW seeding projects.
14. Compile monthly individual and supervised staff work activity reports for all tasks completed.

15. Keep records of maintenance performed on assigned equipment and facilities.
16. Assist supervisor with annual budget preparation and expense tracking for ROW management operations.
17. Submit applications to the Living Roadway Trust Fund and other funding opportunities.

Qualification Requirements

To perform this job successfully, an individual must be able to satisfactorily perform each essential duty. The requirements listed as follows are representative of the knowledge, skill and ability required.

1. Ability to operate and maintain the necessary tools and equipment.
2. Ability to identify native and introduced plant species, including noxious weeds.
3. Ability to organize assigned work and develop efficient strategies to accomplish said work.
4. Ability to establish and maintain effective working relationships with other staff, the general public, special interest groups and individuals from other agencies.
5. Ability to operate personal computers and demonstrate or attain proficiency in Windows, Microsoft Word, Excel and the internet.
6. Ability to continue professional training to remain knowledgeable of current issues, trends and management techniques.
7. Ability to make minor repairs on equipment and facilities not requiring a trained, professional repair person.
8. Ability to work a non-standard work week, including nights and weekends to accomplish the objectives of the position.
9. Ability to maintain accurate safety, work and equipment maintenance records.

The requirements and duties listed above are intended only as illustrations of the various types of work that may be performed. The omission of specific statements of duties does not exclude them from the position if the work is similar, related or a logical assignment to the position.

Education and Experience

Bachelor's degree in a natural resource-related field and a minimum of two years practical work experience in natural resource/vegetation management or any equivalent combination of education, training and experience which provides requisite knowledge, skills and abilities for this position.

Knowledge of the tools and equipment required to perform the job.

Language Skills

1. The ability to communicate effectively with co-workers and the general public.
2. Ability to deal with the general public in a tactful and courteous manner.
3. Ability to properly and effectively communicate verbally and in writing.

Reasoning Ability

1. Ability to apply common-sense understanding to carry out instructions in written, oral or diagram form.
2. Ability to apply common sense to solve problems or achieve work objectives.
3. Ability to recognize work situations that require special attention.
4. Ability to deal with problems involving several variables in standardized situations.

Certificates, Licenses, Registrations

1. Valid Iowa Commercial Drivers License (within 60 days of hire date).
2. Valid Iowa Pesticide Applicator License in category 6, Right-of-way and category 1A, Agriculture.

Physical Demands

The physical demands described here are representative of those that must be met by an employee to successfully perform the essential functions of this job.

1. While performing the duties of this job, the employee is routinely required to stand, walk, sit, operate hand tools, kneel, stoop, balance and climb ladders and equipment. These activities may be required for two or more hours at a time during an 8-10 hour work day.
2. The employee must routinely lift 50-pound objects 40 inches high and carry 15 yards.
3. The specific vision abilities required for this job include: close vision, distant vision, color vision, peripheral vision, depth perception and the ability to adjust focus.

Work Environment

The work environment characteristics described here are representative of those an employee encounters while performing the essential functions of this job.

1. While performing the duties of this job the employee may work around moving parts/equipment.
2. The employee may work outdoors in extreme hot, cold, rainy, snowy and windy weather conditions.
3. The employee may be exposed to dust, fumes and loud noises.

Comments

Must be insurable for driving under county insurance company policies.
Applicant will be subject to post-offer, pre-employment drug and physical testing.

Diversity mix*

Grasses		**lbs./acre**	**Seeds/ft.^{2}**
Big bluestem	*Andropogon gerardii*	1.5	5.50
Sideoats grama	*Bouteloua curtipendula*	2.5	5.50
Canada wildrye	*Elymus canadensis*	2.0	3.80
Switchgrass	*Panicum virgatum*	0.5	2.60
Little bluestem	*Schizachyrium scoparium*	2.5	13.80
Indiangrass	*Sorghastrum nutans*	1.5	6.60
Rough dropseed	*Sporobolus asper*	1.0	11.00
Total		**11.50**	**48.80**

Forbs		**oz./acre**	**Seeds/ft.^{2}**
Lead plant	*Amorpha canascens*	0.8	0.29
Butterfly milkweed	*Asclepias tuberosa*	2.0	0.20
Canada milkvetch	*Astragalus canadensis*	1.6	0.62
White wild indigo	*Baptisia lactea*	1.0	0.04
Partridge pea	*Chamaecrista fasciculata*	32.0	2.00
Prairie coreopsis	*Coreopsis palmata*	0.8	0.18
Purple prairie clover	*Dalea purpurea*	3.2	1.10
Showy tick trefoil	*Desmodium canadense*	0.8	0.10
Pale purple coneflower	*Echinacea pallida*	4.4	0.53
Rattlesnake master	*Eryngium yuccifolium*	2.0	0.34
Ox-eye sunflower	*Heliopsis helianthoides*	4.8	0.69
Roundheaded bushclover	*Lespedeza capitata*	2.0	0.37
Rough blazingstar	*Liatris aspera*	0.8	0.29
Prairie blazingstar	*Liatris pycnostachya*	4.8	1.21
Wild bergamot	*Monarda fistulosa*	1.6	2.57
Stiff goldenrod	*Oligoneuron rigidum*	0.8	0.75
Foxglove penstemon	*Penstemon digitalis*	2.0	5.97
Large-flowered penstemon	*Penstemon grandiflorus*	1.0	0.32
Yellow coneflower	*Ratibida pinnata*	4.8	3.31
Black-eyed Susan	*Rudbeckia hirta*	3.2	6.76
Sweet black-eyed Susan	*Rudbeckia subtomentosa*	0.4	0.39
Wild petunia	*Ruellia humilis*	1.6	0.19
Compass plant	*Silphium laciniatum*	1.2	0.02
Smooth blue aster	*Symphyotrichum laeve*	0.4	0.51
New England aster	*Symphyotrichum novae-angliae*	0.8	1.21
Ohio spiderwort	*Tradescantia ohiensis*	2.4	0.44
Hoary vervain	*Verbena stricta*	0.8	0.51
Ironweed	*Vernonia fasciculata*	0.4	0.22
Culver's root	*Veronicastrum virginicum*	0.4	7.35
Golden Alexanders	*Zizia aurea*	1.6	0.40
Total		**84.40**	**38.76**

continued …

Diversity mix continued:

Wet species**		**oz./acre**	**Seeds/ft.^{2}**
Swamp milkweed	*Asclepias incarnata*	2.8	0.31
Blue joint	*Calamagrostis canadensis*	1.2	7.71
Brown fox sedge	*Carex vulpinoidea*	3.2	7.35
Sneezeweed	*Helenium autumnale*	0.6	1.79
Great blue lobelia	*Lobelia siphilitica*	0.4	4.59
Mountain mint	*Pycnanthemum virginianum*	0.4	2.02
Dark green bulrush	*Scirpus atrovirens*	3.2	33.79
Blue vervain	*Verbena hastata*	0.4	0.85

**Wet species bagged separately for use in moist ditch bottoms.

Ditch clean-out mix*

Grasses		**lbs./acre**	**Seeds/ft.^{2}**
Big bluestem	*Andropogon gerardii*	1.5	5.50
Sideoats grama	*Bouteloua curtipendula*	2.5	5.50
Canada wildrye	*Elymus canadensis*	2.0	3.80
Switchgrass	*Panicum virgatum*	0.5	2.60
Little bluestem	*Schizachyrium scoparium*	2.5	13.80
Indiangrass	*Sorghastrum nutans*	1.5	6.60
Rough dropseed	*Sporobolus asper*	1.0	11.00
Total		**11.50**	**48.80**

Forbs		**oz./acre**	**Seeds/ft.^{2}**
Swamp milkweed	*Asclepias incarnata*	2.8	0.31
Partridge pea	*Chamaecrista fasciculata*	16.0	1.00
Purple prairie clover	*Dalea purpurea*	3.2	1.10
Pale purple coneflower	*Echinacea pallida*	4.4	0.53
Rattlesnake master	*Eryngium yuccifolium*	1.0	0.17
Ox-eye sunflower	*Heliopsis helianthoides*	4.8	0.69
Yellow coneflower	*Ratibida pinnata*	4.8	3.31
Black-eyed Susan	*Rudbeckia hirta*	3.2	6.76
Total		**40.20**	**13.87**

*Mixes change slightly each year based on species availability and prices.

FOLIAR BRUSH CONTROL HERBICIDE RECOMMENDATIONS

Species	Chem-Trol/VMS (2002)*	UAP/Timberland (2002)*	Roadside manager recommendations (2011)
Boxelder	Escort 2 oz. Tordon K	Tordon K Garlon Escort XP	**Garlon/Escort**
Chinese Elm	Escort 2 oz. Garlon 4 Krenite Tordon K	Garlon Dicamba Escort XP Tordon 101	**Garlon/Escort**
Cottonwood	Escort 2 oz. Garlon 4 Krenite	Escort XP Garlon Krenite Dicamba/Vanquish Patron 170	**Garlon/Escort**
Dogwood	n/a	n/a	**Garlon/Escort**
Eastern Red Cedar	Escort 3 oz. Tordon K - w/ non-ionic surfactant	Escort XP Tordon K	**Garlon/Escort** – *Thorough coverage needed.* **Krenite** – *High-volume treatment seems to work on small cedars (< 8 ft.) in July. This may be a function of the surfactant.*
Green Ash	Krenite Escort	Krenite/Tordon K Escort XP Garlon	**Garlon 4/Escort** **Garlon**
Honeysuckle	n/a	n/a	**Roundup** – *Works well but kills understory.* **Garlon/Escort** – *Provides partial control; seems to work best when fall-applied. Surfactant improves results. Two applications in the same year (spring and fall) provides better control.* **Tordon**
Locust	Tordon K	Tordon K/Tordon 101 2,4-D/Dicamba	**Garlon/Escort** **Krenite** **Milestone**
Maple	Escort 2 oz. Krenite Tordon K Garlon 4	Tordon K Arsenal Krenite or Garlon + Tordon or Escort	**Garlon /Escort**
Mulberry	Escort 2 oz. Garlon Krenite	Tordon K Escort XP Stalker/Arsenal Krenite	**Garlon/Escort** **Garlon**
Oak	n/a	n/a	**Garlon/Escort**
Olive, Autumn	n/a	n/a	**Garlon/Escort** – *Provides partial control; seems to work best when fall-applied.*
Plum	Escort 2 oz. Garlon Tordon Krenite	Escort XP Garlon Tordon K Krenite	**Garlon/Escort**
Sumac	Escort Arsenal	Escort XP Garlon Tordon K/Tordon 101 Patron 170	**Garlon/Escort**
Willow	Escort 1 oz. Garlon 4 Krenite	2,4-D same as cottonwood	**Garlon/Escort** **Krenite**

Roadside manager notes (2011) – Foliar herbicide:

- Garlon/Escort is a common mix for brush control. Garlon 4 and Garlon 3A can be used. See note below *Table 2* (page 47).
- We quit spraying Tordon in roadside situations due to standing water and high water tables.
- Arsenal usually kills cool season grass, which can eventually create thistle problems. We limit its use to Japanese Knotweed.
- We've had good luck with Opensight at 3.3 oz. per acre + an additional 1 oz. per acre of Escort on all of these trees.
- Honeysuckle control is difficult. When isolated patches are found, consider basal treatment.

BASAL BARK BRUSH CONTROL HERBICIDE RECOMMENDATIONS

Species	(2002)	Roadside manager recommendations (2011)
Black Locust	Garlon 4	**Garlon 4**
Boxelder	Pathfinder 2 Garlon 4	**Garlon 4**
Chinese Elm	Pathfinder 2 Garlon 4	**Garlon 4**
Cottonwood	Garlon 4 (+ Stalker optional)	**Garlon 4**
Eastern Red Cedar	Pathfinder 2 Garlon 4 (poor)	**25% Garlon 4** (Works fair to well on trees < 8 ft.)
Honeysuckle	n/a	**Garlon 4** (+ 1% Stalker, optional. Hacking bark with pocket saw before spraying improves results. Cut stump treatment is best for bigger plants.)
Mulberry	n/a	**Garlon 4** (Hacking bark with pocket saw before spraying may improve results.)
Oak	Garlon 4	**Garlon 4**
Poplar	Garlon 4	**Garlon 4**
Sumac	Pathfinder 2 Garlon 4	**Garlon 4**
Willow	Stalker + Garlon 4	**Garlon 4** (No need to include Stalker.)

Roadside manager notes (2011) – Basal bark herbicide:

- We've started adding about 0.5-1% Stalker to our 25% Garlon 4 mix. We used to add 3% Stalker, but our "ring of death" seemed to last for three or more years rather than just one.
- It helps to hack up thick- or corky-barked trees and trees > 2 in. in diameter.
- For most trees, we use 2.5 gal. Garlon + 4 qt. Stalker + 12.5 gal. diesel fuel or basal oil to make about a 15 gal. mix.

* 2002 herbicide recommendations taken from Tree and Brush Control for County Road Right-of-Way.

Iowa Pesticide Applicator Licenses and Certifications

Certified Applicators

Each individual who applies pesticides for a state or county agency, municipal corporation or other government entity is required to be *certified*. Certified public applicators may obtain a one-year certification for $10 or a three-year certification for $15. *Certifications are valid only when associated with a valid licensed agency.* Written examinations are required for first-time applicators. Written exams are also required for individuals adding on certification categories and those persons choosing not to maintain continuing instruction credit hours.

The core examination and appropriate category test(s) must be successfully passed before application for certification can be made. Additional categories may be added anytime with no extra charge. Any category will carry the same expiration date as the card on which it is added. Each certified individual must be listed as an applicator under a current Iowa pesticide applicator license for that certification to be valid.

Renewal of Applicator Certifications

Each applicator is placed on a three-year "qualification cycle." During those three years, an applicator may maintain a single-year certification by submitting a one-year fee and renewal form. (Certification renewal forms are provided by the Pesticide Bureau.) A 30-day grace period from the date of expiration will be allowed for the renewal of the certification. At the end of the qualification cycle each applicator must indicate a method of renewal by:

1. Declaring that at least two hours of continuing instruction *for each certified application category* has been received for *each* of the previous three years and verification of having received training is on file with the applicator's employer; or,
2. Completing written tests at the end of the third year of the "qualification cycle;" or,
3. Maintaining a combination of training and testing.

Note: An applicator who misses two hours of training for any one category for any one year is required to complete written tests for that particular category. There are no provisions for "making up" missed continuing instruction hours to avoid the written test.

Written applicator tests are offered daily, Monday through Friday from 9 a.m. to 3 p.m. at the Wallace Building at East Ninth and Grand in Des Moines. If a group of ten or more is involved, please call (515) 281-4339 or (515) 286-5601 and make an appointment. Otherwise, no appointment is necessary. Photo identification is required. Tests are also offered on a limited basis at some cooperative extension service area offices. Please contact either the area office or the Pesticide Bureau for a current testing schedule.

Contact information

Licensing & Certification.....515-281-5601
Certification Testing Information.....515-281-8591
Pesticide General Information.....515-281-8591

Restricted-use Pesticide Recordkeeping

These rules apply to both certified private and commercial applicators. The Iowa Pesticide Act requires applicators to keep records of all pesticide applications for 3 years. The federal regulations require pesticide applicators to record the following information within 14 days of the restricted use pesticide application:

- The brand or product name and the EPA registration number of the restricted use pesticide that was applied.
- The total amount of the restricted-use pesticide applied.
- The location of the application.
- The size of the area treated.
- The crop, commodity, stored product or site to which the pesticide was applied.
- The month, day and year on which the restricted-use pesticide application occurred.
- The name and certification number of the certified applicator who applied the restricted-use pesticide.

More information can found in this IDALS document.

Appendix 6a – Sample Press Release

Press Release (MSWord)

PRAIRIE COUNTY ENGINEER
1234 HIGHWAY 1
PRAIRIE CITY, IOWA 54321
555-123-4567

FOR IMMEDIATE RELEASE

Date: March 1, 2008

Contact: Mike Jones, Prairie County Roadside Manager – 555-123-4567

Prescribed Burning in County Rights-of-way

Prairie County IRVM will be conducting prescribed burns in county road rights-of-way during the next few months. Prescribed burns are an effective resource management tool utilized to discourage the growth of weeds and woody vegetation, while promoting the growth of desired native vegetation in roadside prairie sites. All staff members are certified in wildland firefighting and take all necessary safety precautions to minimize the risks associated with a prescribed fire. Please use caution when approaching a burn site as staff members and equipment may be near the traveled portion of the road.

For more information contact the IRVM office at 555-123-4567.

Appendix 6b – Sample Adjacent Landowner Notification

Landowner notification (MSWord)

PRAIRIE COUNTY ENGINEER
1234 HIGHWAY 1
PRAIRIE CITY, IOWA 54321
555-123-4567

MEMO

TO: RESIDENT

FROM: MIKE JONES

DATE: MARCH 10, 2008

RE: CONTROLLED BURNING IN RIGHT-OF-WAY

(address)

In order to encourage the establishment of native plant communities in our roadsides, different management techniques must be used along with our more traditional methods of mowing and spraying. Prescribed burning (not to be confused with *wildfire*) is any fire ignited by management actions to meet specific objectives. Goals of prescribed burns in terms of roadside management include stimulating growth of desirable species such as native grasses and flowers, impeding growth of undesirable species such as weeds and woody vegetation, and giving desirable species a competitive advantage over other species. In some instances, a prescribed burn may replace the need to use herbicides in the ROW.

A prescribed burn for the right-of-way in the vicinity of your residence is scheduled for this spring. The burn will be conducted only by properly trained personnel and only under the safest conditions. The purpose of this memo is to notify you that a) a prescribed burn will take place, b) smoke will be produced in and around the vicinity of the burn for a short time, and c) this action may require minor traffic control around your residence.

Specific location:

Right-of way on Apple Ave. between 120th Avenue and 130th Avenue

For any questions, comments, or concerns about this notice, please contact:

Mike Jones - Roadside Manager / Weed Commissioner
Prairie County Secondary Roads Department
1234 Hwy 1
Prairie City, IA 54321
Ph. 555-123-4567

Appendix 6c – Sample Burn Site Spreadsheet

Burn spreadsheet (Excel)

Burn history

Site ID #	Location	Wind direction	Last burn
1996-7	N side 150th W of Juniper Ave	S	4/24/1998
1995-10	E side Tulip Ave S of 290th	W	12/10/1998
1996-17	S side 150th W of Juniper Ave	N	4/15/2002
1997-7	S side 300th W of Sumac Ave	N	3/31/2004
1997-9	W side Sumac Ave S of B20	E	3/31/2004
1992-2	S side 130th J-I	N	4/1/2004
2002-5	W side Violet Ave N of 150th	E	10/15/2004
1994-5	N side 120 S-T	S	11/15/2004
1998-1	Triangle @ 260th & Finch Ave	NW	11/23/2004
1996-13	S side B15 W of Prairie Ave	N	4/7/2005
1991-1	S side 265th W of Oak Ave	N	4/12/2005
1995-13	S side 320th E of Bluebird Ave	N	4/13/2005
1996-12	S side 310th E of Phlox Ave	N	4/13/2005
1996-1	N side 160th E of Robin Ave	S	4/15/2005
1995-20	N triangle Basswood Ave & 300th	SE	4/6/2006
2001-5	S side 200th E of Maple Ave	N	4/12/2006
2002-4	S side 210th W of Nuthatch Ave	N	4/12/2006
1995-17	S triangle 320th & Killdeer Ave	E	4/17/2006
1995-21	S triangle Dogwood Ave & 300th	NE	4/17/2006
1997-5	E side Tulip Ave N of 290th	W	4/19/2006
1994-1	S triangle 150th & Violet Ave	W	4/20/2006
1994-6	S triangle 130th & Eagle	N, W	4/20/2006
1994-4	E side Tulip Ave S of 320th	W	4/21/2006
1995-12	E side Tulip Ave S of 320th	W	4/21/2006
1997-8	E side Sparrow Ave S of 300th	W	4/21/2006
1995-15	S side 330th E of Larkspur Ave	N	4/25/2006
2000-2	S side 330th W of Prairie Ave	N	4/25/2006
2001-1	S side 250th T-V	N	4/25/2006
2004-2	E side Tulip Ave N of 170th	W	11/20/2006
1998-4	Bridge 290th E of Spruce Ave	S	11/22/2006
2003-3	Triangle @ Apple Ave & 220th	S	11/22/2006
2005-2	W side Ash Ave N of 210th	E	11/22/2006
1995-2	S side 150th E of Hickory Ave	N	4/9/2007
1995-22	S side 150th W of Walnut Ave	N	4/9/2007
1995-4	S side 160th E of Sycamore Ave	N	4/9/2007

Last updated: 05/01/07

Burn plan (MSWord)

Prescribed Burn Management Plan

Location: *West side of Apple Ave. between 120th St. and 130th St.*

Prescribed burn parameter for this location

Temperature: *40 – 70 F*

Wind direction(s): *East or southeast*

Wind speed: *<15 mph*

Relative humidity (%): *>30%*

Personnel requirements: *1 crew boss, 1 additional*

Equipment requirements: *1 pump truck (300 gal), hand tools, 1 backpack sprayer*

Potential hazards: *Wood utility poles (x6)*
Phone box 20 yds. north of farm drive
Corn stubble in adjacent field (tilled)
Stop sign
Plastic culvert under farm drive

Prepared fire breaks required

Description: *Wet line near intersection of Apple Ave. and 120th St.*
Wet lines around potential hazards

Potential anchor points: *Northwest or southwest corners*

Special concerns: *Heavy traffic on Apple Ave. after 3 p.m.*
Acreages/farms located to the west and northwest

Notes:
Smooth brome abundant on the north end – early spring burn desired

Emergency Phone:	*Conservation Board Office*	*555-111-5678*
Local Fire District:	*Prairie City Fire Dep't.*	*555-111-8765*

Weather data (MSWord)

Prescribed Burn Weather Information

Location:	*West side of Apple Ave. between 120th St. and 130th St.*	
Date:	*April 18, 2008*	
Personnel:	*(Crew boss)*	*Mike Jones*
	(Crew)	*James Smith*

Forecasted weather data

Source:	*NOAA*
Forecast time frame:	*9 a.m. – 11 a.m.*
Temperature:	*60 – 68 F*
Relative humidity (%):	*55 – 62%*
Dewpoint:	*32 F*
Wind direction:	*Southeast*
Wind speed:	*7 - 10 mph*
Cloud cover:	*Partly cloudy*

Beginning on-site weather data

Time:	*9:35 a.m.*
Temperature:	*64 F*
Relative humidity (%):	*58%*
Dewpoint:	*32 F*
Wind direction:	*ESE*
Wind speed:	*8 - 10 mph*
Cloud cover:	*Mostly sunny*

Ending on-site weather data

Time:	*10:15 a.m.*
Temperature:	*66 F*
Relative humidity (%):	*53%*
Dewpoint:	*30 F*
Wind direction:	*SE*
Wind speed:	*8 - 10 mph*
Cloud cover:	*Partly cloudy*

Notes:
90% burn – approximately 2 acres

Print Resources for Roadside Managers

Native plant and seedling guides

An Illustrated Guide to Iowa Prairie Plants. Christiansen, P. and M. Muller. 1999.

Central Region Seedling ID Guide for Native Prairie Plants. USDA - NRCS Elsberry Plant Materials Center and the Missouri DOC. 2005. (Download)

How to Know the Grasses. Pohl, Richard W. 1978.

The Prairie Seedling Guide, 2nd Ed. Bockenstedt, P. 2007. (Download)

Roadside Plants and Flowers. Edsall, M. 1985.

The Tallgrass Prairie Center Guide to Seed and Seedling Identification in the Upper Midwest. Williams, D. 2010.

Tallgrass Prairie Wildflowers: A Field Guide to Common Wildflowers and Plants of the Prairie Midwest. Ladd, D. and F. Oberle, 1995.

The Vascular Plants of Iowa. Eilers, L. and D. Roosa. 1994.

Wetland Plants and Plant Communities of Minnesota and Wisconsin, 2nd Ed. Eggers, S. and D. Reed. 1997.

Wildflowers of the Tallgrass Prairie, The Upper Midwest, 2nd Ed. Runkel, S. and D. Roosa. 2010.

Restoration and Management guides

A Practical Guide to Prairie Reconstruction. Kurtz, C. 2001.

The Ecology and Management of Prairies in the Central United States. Helzer, C. 2009.

The Tallgrass Prairie Center Guide to Prairie Restoration in the Upper Midwest. Smith, D., D. Williams, G. Houseal and K. Henderson. 2010.

The Tallgrass Prairie Center's Native Seed Production Manual. Houseal, G. 2007.

The Tallgrass Restoration Handbook, Revised Ed. Packard, S. and C. Mutel. 2005.

Tree and Brush Control for County Road Right-of-Way. Williams, W. 2002

Weed and weed seedling guides

A Field Guide to Terrestrial Invasive Plants in Wisconsin. Wisconsin DNR. 2010. (Download)

Common Weed Seedlings of the North Central States, Reprint. Chomas, A., J. Kells and J. Carey. 2001. (Download)

Invasive Plants of the Upper Midwest: An Illustrated Guide to Their Identification and Control. Czarapata, E. 2005.

Weeds of the Midwestern U.S. & Central Canada. Bryson, C., M. DeFelice and A. Evans. 2010.

Weeds of Nebraska and the Great Plains. Nebraska Department of Agriculture. 1995.

Weeds of the Northern U.S. and Canada: A Guide for Identification. Royer, F. and R. Dickinson. 1999.